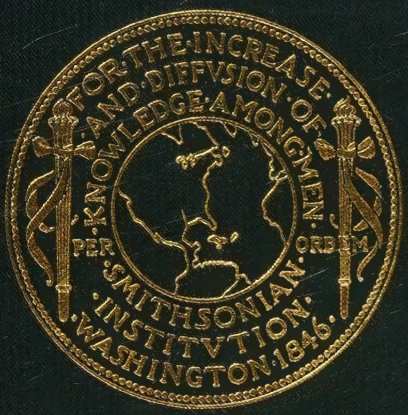
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UNITED STATES NATIONAL MUSEUM

PROCEEDINGS

OF THE

UNITED STATES NATIONAL MUSEUM

VOLUME 53

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

ADVERTISEMENT.

The scientific publications of the National Museum consist of two series—Proceedings and Bulletins.

The Proceedings, the first volume of which was issued in 1878, are intended primarily as a medium for the publication of original papers based on the collections of the National Museum, setting forth newly acquired facts in biology, anthropology, and geology derived therefrom, or containing descriptions of new forms and revisions of limited groups. A volume is issued annually or oftener for distribution to libraries and scientific establishments, and, in view of the importance of the more prompt dissemination of new facts, a limited edition of each paper is printed in pamphlet form in advance. The dates at which these separate papers are published are recorded in the table of contents of the volume.

The present volume is the fifty-third of this series.

The Bulletin, publication of which was begun in 1875, is a series of more elaborate papers, issued separately, and, like the Proceedings, based chiefly on the collections of the National Museum.

A quarto form of the Bulletin, known as the "Special Bulletin," has been adopted in a few instances in which a larger page was deemed indispensable.

Since 1902 the volumes of the series known as "Contributions from the National Herbarium," and containing papers relating to the botanical collections of the Museum, have been published as Bulletins.

RICHARD RATHBUN,
Assistant Secretary, Smithsonian Institution,
in charge of the United States National Museum.

DECEMBER 19, 1917.

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NORTH AMERICAN PARASITIC COPEPODS BELONGING TO THE LERNAEIDAE WITH A REVISION OF THE ENTIRE FAMILY.

By Charles Branch Wilson,

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INTRODUCTION.

The present is the thirteenth[1] paper in the series dealing with the parasitic copepods in the collection of the United States National Museum, and comprises the family of the Lernaeidae.

This is the oldest family of the parasitic copepods and includes some of the most eccentric and bizarre forms. The genera composing the family have often been wrongly interpreted, and their systematic position and arrangement have been mere conjectures. This was largely because they were imperfectly understood and nothing was known of the male sex or of the life history.

The development of *Pennella* consists of a broken series of larval forms described by different authors—Steenstrup and Lütken (1861), Lubbock (1860), Wierzejski (1877), Brady (1883), Lütken (1893), and M. T. Thompson (1905).

The development of *Lernaeocera* (*Lernaea*) was worked out in admirable shape by Pedaschenko in 1898 and by A. Scott in 1901. That of *Sarcotretes* was published by Jungersen in 1911, and the life history of *Lernaea* (*Lernaeocera*) has just been completed by the present author. We thus have now a life history for each of the four subfamilies. These have all been included in a condensed form

[1] The 12 preceding papers, all of which were published in the Proceedings of the United States National Museum, are: 1. The Argulidae, vol. 25, pp. 635–742, pls. 8–27. 2. Descriptions of Argulidae, vol. 27, pp. 627–655, 38 text figures. 3. The Caliginae, vol. 28, pp. 479–672, pls. 5–29. 4. The Trebiinae and Euryphorinae, vol. 31, pp. 669–720, pls. 15–20. 5. Additional Notes on the Argulidae, vol. 32, pp. 411–424, pls. 29–32. 6. The Pandarinae and Cecropinae, vol. 33, pp. 323–490, pls. 17–43. 7. New Species of Caliginae, vol. 33, pp. 593–627, pls. 49–56. 8. Parasitic Copepods from the Pacific Coast, vol. 35, pp. 431–481, pls. 66–83. 9. Development of Achtheres amblopliti Kellicott, vol. 39, pp. 189–226, pls. 29–36. 10. The Ergasilidae, vol. 39, pp. 263–400, pls. 41–60. 11. Descriptions of New Genera and Species, vol. 39, pp. 625–634, pls. 65–68. 12. The Lernaeopodidae, vol. 47, pp. 565–729, pls. 25–56.

in the present paper, because of the opportunity thus afforded for comparison and inference.

A. Scott (1901) and Sir William Turner (1905) are the only authors who have verified the internal anatomy of the species they described by means of sections; the others have relied entirely upon what could be seen through the body walls. Scott described *Lernaeocera branchialis*, while Turner portrayed *Pennella balaenopterae*, representatives of two of the four subfamilies. In the preparation of the present paper various species of the genera *Lernaea*, *Lernaeenicus*, *Peniculus*, and *Collipravus* have been studied by means of serial sections, thus supplementing and completing the work of Scott and Turner.

It was further found after trial with various reagents that if specimens were properly dehydrated in absolute alcohol and entirely cleared in clove oil, they became so transparent that the internal anatomy in all its details was clearly visible without sectioning. Nearly every species described in the present paper has been treated in this manner, and the internal specific and generic characters have been thus determined.

Hence the systematization here proposed is the result of a careful study of the life history and of both external and internal morphology, and is substantiated by serial sections.

Much of the work was done at the laboratory of the Bureau of Fisheries at Fairport, Iowa, during the summers of 1914, 1915, and 1916.

That portion of the work which concerned the genus *Lernaea*, which is parasitic upon fresh-water fishes, and the material for which was collected at Fairport, has already been reported to the United States Bureau of Fisheries. The remainder of the work is incorporated in the present paper, and as here constituted the family Lernaeidae includes 17 genera, three of which—*Cardiodectes*, *Collipravus*, and *Trifur*—are new to science, and 80 species, of which 15 are new. There are seven generic names which have been introduced into this family, each of which is composed of the name *Lernaea* or the corresponding adjective *Lernaios* and some other word. Two of these compound names, *Lernaeopoda* and *Lernaeomyzon*, belong in the family Lernaeopodidae; two others, *Lernaeonema* and *Lernaeopenna*, are synonyms; the remaining three, *Lernaeenicus*, *Lernaeocera*, and *Lernaeolophus*, are still valid genera in the present family. In the author's opinion, the first part of all these names should be spelled alike, since each represents the same word which was in existence and whose spelling had been determined long before any of the compounds were formed.

HISTORY.

Early literature and natural history.—Most of the genera and species belonging to this family are buried in the flesh of their host, with the posterior portion of the body and the egg tubes hanging free in the surrounding water so as to be readily seen when the fish are handled. Many of the species also are of exceptionally large size, reaching 4 and sometimes even 6 inches in length. Such remarkable size and prominence called them to the attention of fishermen at a very early date, and we find mention of these parasites in several of the classical writers, the stories about them doubtless being derived from the fishermen.

Aristotle, Pliny, Oppianus, and Athenaeus all described the sufferings of the tunny and swordfish in the Mediterranean in consequence of the irritation caused by these pests. Two of the early natural histories, Aquatilium Animalium Historiae by Salviani (1554, p. 126) and Libri de piscibus marinis by Rondelet (1554, p. 249), repeated these accounts, and the latter author gave a figure of a tunny with one of the copepods fastened near the pectoral fin. Conrad Gesner, in his Historia Animalium—De Aquatilibus (1560, p. 112), gave a more extended account of the parasite, described its structure and appearance, and presented an enlarged figure of it, besides repeating the figure given by Rondelet. But his description and figure resemble a Lernaeopod far more than they do a Lernaean. Boccone, in his Recherches et Observations naturelles (1671, p. 284), tells us that the fishermen on the coast of Messina knew of another parasite which they called "Sanguisuca," and which buried itself in the flesh of the swordfish; and he adds with reference to it . . . "This sangsue appears to be tormented by a louse which I have never seen on any other animal. It is of the size of a pea and attaches itself firmly to the animal" (p. 292). Boccone considered his species the same as that of Gesner, but the figures he gave proved it to be a *Pennella*, while the "louse" on it was doubtless a goose barnacle similar to those shown in figure 147.

Lernaea and *Lernaeocera*.—Linnaeus obtained from a European carp, to which he gave the name "*Cyprinus carassius*," a parasite upon which he established the genus *Lernea* in 1746,[1] calling the species simply "*Lernea tentaculis quatuor*." In the following year he described another species, from the gills of a *Gadus*, under the designation "*Lernea cauda duplici tereti*."[2] In the tenth edition of his Systema Naturae (1758, p. 655) he designated the first of these species as *Lernea cyprinacea*, the second one as *L. asellina*, and he transferred to this genus *Lernaea* a third species, *salmonea*, which

[1] Fauna Suecica, p. 367, fig. 1282.
[2] Iter Westrogotha, 1747, p. 171, pl. 3, fig. 4, *a* and *b*.

had been described by Gissler under the name *Pediculus salmonis*,[1] arranging the three species in the order named.

Accordingly the species *cypinacea*, upon which the genus was originally founded, and which stands first in this tenth edition, becomes the oldest species in the family. It was the ostensible genus type for nearly a century, and it may well be restored to that position.

The second species, *asellina*, is a typical Chondracanthid, while the third, *salmonea*, is as typical a Lernaeopod, so that neither of them can be even retained in the family.

In the twelfth edition another new species, *branchialis*, was added to the genus and was placed first, but the genus diagnosis remained unchanged.

For many years every newly discovered parasite, whatever its structure might be, was referred to the genus *Lernaea*, which thus came to include a large number of heterogeneous species. Many of these have since been established as distinct genera. The first to be thus established was the species *branchialis*, which was made the type of a genus called "*Lerneocera*" by Blainville in 1822 (p. 376). Blainville included in his genus, besides the species *branchialis*, Müller's *Lernaea cyclopterina*, a new species which he named *surriraiis*, and unfortunately Linnaeus's *Lernaea cyprinacea*. If he had only omitted this last species, which of course he had not the slightest excuse for including, since it was Linnaeus's type species, the two genera would never have been exchanged, but, as it was, his mistake was copied by Desmarest (1825), Nordmann (1832), Burmeister (1833), Krøyer (1837), and Milne Edwards (1840). The latter explained that Nordmann, Burmeister, and Krøyer had restricted Blainville's generic name to such species as had soft symmetric horns on the head and straight multiseriate egg strings, and he adopted their restriction. Blainville, however, distinctly stated in his genus diagnosis that *Lernacocera* had three immovable and branched chitin horns, two lateral and one dorsal (p. 375). And under the type species he said, "The egg sacks arise from just in front of the posterior extremity of the body and are much twisted or coiled" (p. 376). Furthermore, he stated plainly that he had never seen the species *cyprinacea*, but only the figure published by Linnaeus, which did not show the egg sacks.

In other words, the authors above quoted deliberately exchanged the two genus names to suit their own fancy, took away from Linnaeus's genus *Lernaea* the species which had served as its type for 90 years, and substituted for it the species which Blainville had made the type of his genus *Lernaeocera*, and forced upon Blainville, as a

[1] Kongl. Svensk. Vetensk. Acad. Handlingar, 1751, vol. 12, p. 185, pl. 6, figs. 1 to 5.

substitute type, a species which did not agree with his genus diagnosis and which he had never seen.

In such a dilemma only one course is possible, and that is to restore the two genera to their proper places, in spite of the great inconvenience which will result, and this has been done. The author sincerely regrets the necessity for such a change, especially when the genera are so widely known and so often quoted, but the evidence is so convincing as to leave no choice in the matter, and both Linnæus and Blainville have claims for justice which far outweigh any temporary embarrassment.

Location of the Lernaeans.—The early Lernaeans were so eccentric and apparently lacked so many of the usual crustacean appendages that Linnaeus did not suspect them of being crustacea, and placed them amongst the worms, characterizing them by the softness of their body and the absence of a shell. Hans Ström in the first part of his Physisk og Oeconomisk Beskrivelse (1762, p. 167), under the heading of insects, described both sexes of "*Lernaea salmonis*" and the females of "*L. uncinata.*" On page 209 he described *Lernaea corpore tereti flexuosa*, which Linnæus afterward identified as *L. branchialis* and placed with his other species among the worms.

O. F. Müller, in Zoologiae Danicae Prodromus (1776, p. 226), gave 11 species of *Lernaea;* Fabricius, in Fauna Groenlandica (1780, p. 336), gave 7 species; Hermann (1783), Schrank (1786), Lamartinière (1787), Brugières (1792), and Holten (1802) all added species of *Lernaea* and all adopted Linnaeus's system of classification. Cuvier, in his Tableau elementaire (1798, p. 389), placed the Lernaeans under "Mollusques gasteropods" in the division of those having free motion in water. Lamarck, in his Systême des Animaux sans vertèbres (1801), also placed them under the mollusks but under "Mollusques cephales."

Bosc published an Histoire Naturelle des Crustacés in 1802, but although he gave an excellent historical summary and a good account to date of *Caligus*, *Argulus*, *Cecrops*, *Dichelestium*, etc., he included none of the Lernaeans, which was equivalent to saying that he did not consider them as crustaceans. In an Historia Vermium (n. d.) published shortly afterwards he described (p. 51) 15 Lernaean species, placing them among the mollusks, but stating that they approached the intestinal worms. Lamarck, dissatisfied with his first attempt, removed the Lernaeans from the mollusks in his Philosophie Zoologie, 1809, and placed them among the annelids. Three years later, in Extrait du Cours de Zoologie and again in Histoire Naturelle des Animaux sans Vertèbres (1816), he showed the need of forming a separate class to receive these animals, which he named "Epizoaires," and which, he said, "may properly fill up the great void which exists between insects and worms."

In 1815–16 Oken published a Lehrbuch Naturgeschichte, in which he placed the Lernaeans as the third family in the order of "Erdleche oder Geschlechtsleche," and in this family were included all the parasitic copepods then known (p. 181). Later, in the same book (p. 357), he revised his classification, which contained many errors and called the group "Armwurmer," dividing it into two tribes, the Lernaeans containing four genera, *Axine*, *Clavella*, *Pennella*, and *Lernaea*, and the Argulids, containing also four genera, *Inops*, *Dichelestium*, *Caligus*, and *Argulus*. Thus was shown for the first time the relations between the Lernaeans and the other copepod parasites. In 1817 Cuvier, in his Regne Animal, adopted the view taken by Bosc, placing the Lernaeans among the intestinal worms, while he located the other parasitic copepods among the crustacea.

Soon afterwards Surriray made the important discovery that the long filaments suspended from the body of these animals contained eggs and that the young when hatched bore no resemblance to the adults, but were very similar to the young of *Cyclops*—that is, they were crustaceans and not worms.

Blainville, in his Mémoire sur les Lernées (1822), admitted the truth of Surriray's statement and fully established the Lernaeans among the crustacea, where they have remained ever since.

ECOLOGY.

Sexual dimorphism.—The females of the Lernaeidae are fixed parasites, and consequently there is a complete loss of the power of locomotion, although the swimming legs are usually retained, and there is great diversity in the means of prehension. Since the male does not finally become a fixed parasite, but remains upon his first host or swims about freely until his death, there is not the sexual dimorphism which was seen in the Lernaeopodidae. Indeed, it can not be said that there is any real dimorphism at all, because so long as the two sexes remain together and during the period of sexual union they are of the same size, and it is only after the female has become a fixed parasite for the second time and the male has perished, that the former increases enormously and becomes misshapen.

The body of the female is always a little longer than that of the male, and just before as well as for some time after fertilization the genital segment increases greatly in length, but remains of the same width, thus giving the female larva an exceptionally elongated form. A considerable portion of this increase takes place during the second free swimming period, so that by the close of this period there is a marked difference in the length of the fused genital segment and abdomen between the female and such males as still survive; but in other respects the two sexes are alike.

Consequently the only dimorphism would be one of length and not of structure, a difference which is common to all copepods, but is here carried a little farther than usual.

Locomotion.—Judging by the size one would say that the larvae alone possess the power of locomotion, and that the adults are fixed parasites.

But we must remember that sexual union takes place during the first parasitic period, and that it is followed by a second period of free swimming during which both the male and female must be sexually mature.

Moreover, the male never develops any farther, so that he is as fully matured as he will ever become, and the subsequent development of the female is a retrograde metamorphosis rather than an evolution. Accordingly, we are justified in saying that both the larvae and the sexually mature adults are capable of free swimming, and in proof of this both are frequently taken in tow. The majority of males remain attached to their host after sexual union, but all the females and a small percentage of the males (4 per cent) disengage themselves and become free swimmers for a second time. Each of these free-swimming periods is fully as long as that of the Lernaeopod larva, so that the two together give the Lernaeid larva twice as much free swimming as is enjoyed by the Lernaeopodidae.

In the nauplius and metanauplius larvae the swimming motion is jerky and more or less spiral in direction; in the copepodid larvae it becomes faster and more continuous, although it still remains somewhat spiral.

These larvae dart about by spasmodic contractions of the swimming legs and search for something to which they can fasten themselves. If they find nothing suitable they swim about until tired, come to rest upon their backs on the bottom of the aquarium, and remain thus for long periods.

Prehension.—On seeking its first or temporary host the larva uses its second antennae and maxillipeds for prehension. After settling upon the gills in this manner it either continues to use these appendages like *Lernaea*, or fastens itself by a broad frontal filament to the tip of the gill filament like *Lernaeocera*, *Sarcotretes*, and *Pennella*. In the former case no change is produced in the host's gills, but in the latter case the attachment of the parasite's frontal filament to the fish's gill causes the gill to swell up and become tumid, while the filamentous plates disappear on both sides for some distance from the tip.

One or the other of these two modes of prehension, or both of them, are the only ones ever practiced by the male; but the female when she searches out a final host adopts a third method. She bur-

rows or pushes her cephalothorax into the host's flesh until it is completely buried and only the genital segment and abdomen are left on the outside.

From the sides of the head and anterior thoracic segments horns and processes of various sorts now grow out into the flesh of the host and eventually anchor the parasite so firmly that it can not be removed except by cutting away the flesh. The irritation produced by the horns develops a tough membrane or skin immediately around them, which adds considerably to the security of prehension. This tough membrane also envelops the free thorax or neck of the parasite and reaches as far as the real skin of the host. In addition to the horns there also grow out on the front of the head in *Pennella*, *Peroderma*, and *Cardiodectes* curious misshapen warts and excrescences. In *Haemobaphes* there are no real horns but only laminate processes, flattened dorso-ventrally, and the free thorax is reflexed upon itself so that the head points backward instead of forward, and the sides of the cephalothorax and the first two or three thorax segments are prolonged laterally.

Baudouin writes (1905*c*, p. 720) that *Lernaeenicus sardinae* is able to cling with its cephalothorax to the vertebral column of its host as a woodpecker clings to the trunk of a tree, which would be still another or fourth method of prehension. He does not explain this prehension any further than to say that it is * * * "de façon a s'assurer d'un solide point d'appui sur ce poisson très mobile et très agile" (the sardine). However, from text figures accompanying his paper we can see that the grip upon the backbone is obtained by the short horns which grow out from the cephalothorax. The anterior horn is curved over ventrally around the ventral surface of one of the fish's vertebrae, the lateral horns are curled into the spaces between this vertebra and the one next to it on either side, while the ventral surface of the parasite's cephalothorax is applied to the side of the vertebra. The horns being cartilaginous and rigid furnish a secure grip, which holds the parasite's head in close contact with the fish's aorta.

Furthermore, in the case of *Pennella*, in addition to the tough membrane around the head and thorax, the irritation penetrates the surrounding tissue and causes the formation of an enormous cyst as large as an English walnut or even sometimes attaining the size of a lemon, and having the consistency of cartilage. Inside of this the head and neck of the parasite is often twisted in corkscrew fashion, thereby greatly increasing the difficulty of extracting them uninjured.

Whichever method of prehension may be adopted by the adult female can not afterwards be broken, but is kept throughout her life, and may even continue longer. The author has repeatedly cut out

of swordfish the chitin horns and portions of the cephalothorax of females of the genus *Pennella*, which had been dead so long that the remainder of their bodies had decayed and dropped off. The same may be said of *Lernaeocera branchialis*, whose chitin horns are often found in the throat of codfish and other Gadidae. By thus burying the cephalothorax in the flesh of the host the mouth of the parasite is brought close to some large blood vessel, from whence it can derive nourishment.

Burrowing.—The different genera choose different blood vessels and also different points on the outside of the host's body from which to commence their burrowing. These differences will be found stated for each genus under the generic characters. Of course the larger the fish infested by the parasite the greater the distance it must penetrate. In the case of *Pennella* on a large swordfish this distance sometimes reaches 15 or 20 cm.

It seems probable that this burrowing through the flesh is what causes the intense irritation mentioned by Aristotle, Pliny, and others in the tunny and swordfish, when the latter leap out of the water and often fall on board of ships.

The actual method of burrowing has never been witnessed, nor from the nature of the case is it likely to be, but there are certain inferences with reference to it which are inevitable. In the first place we know that it is not accomplished by any special or temporary organs, for no indications of anything of this sort have ever been discovered in the larvae.

On examining the regular appendages with a view of selecting those best adapted for burrowing, attention is at once drawn toward the second antennae and also the maxillipeds in such species as possess them.

The antennae are exceptionally large and powerful at the very time when the burrowing begins, and are armed with strong chelae. Moreover they are on the frontal margin of the head at first and are then transferred to the dorsal surface. Inasmuch as this is true of every one of these burrowing genera but is found in no other family of copepods there must be some significance in it. At least it would seem to show that these antennae are used in burrowing.

The burrowing is preceded and may be accompained by an elongation of the thorax and abdomen of the parasite. In the gill parasite *Lernaeocera* A. Scott stated that the genital segment elongates to fully 15 times its original length. The increase is probably much greater in *Pennella*, *Lernaea*, and other body parasites; Brian figured a young female *Pennella* in which the cephalic horns had not yet begun to develop as being 65 mm. in length. Ordinarily the burrowing must be completed before the horns and processes on the

cephalothorax begin to grow, since it would be manifestly impossible to move a set of long branched horns through flesh.

Torsion.—Baudouin (1905*b*), Quidor (1912), and some other observers have called attention to the torsion or twisting of the body of the adult females, which may be due to several causes. The anterior portion of the parasite's body is buried in the tissues of the host, and is held rigidly in place by the horns and lateral processes of the cephalothorax, and by the tough cyst that forms around them. The posterior portion of the body hangs freely in the water and can be moved in any direction.

When the parasite takes a position on its final host we may assume that its own long axis is parallel with that of the host (external parasites), or with the water current (gill parasites). The body of these female parasites is greatly elongated, while the antennae and mouth parts are close to the anterior end. Consequently when the parasite attaches itself to the fish and begins to burrow its way into the flesh the long body will trail backward in the water in such a way as to offer the least resistance. Furthermore the fish's scales are arranged in such a way that if the external parasite is to burrow under them, as is often the case, it must assume this position. At first the posterior portion of the body would have a tendency to stand out from the surface of the fish, but it is quickly bent by the resistance of the water and thus the body of the parasite comes to have a curve or bend just where it leaves the body of the host. The angle of this bend varies with the direction taken by the burrowing copepod. If the latter bores its way into the host at right angles to the surface (*Sarcotretes*) the bend in its body will be approximately a right angle; but if the parasite bores in obliquely the angle will be larger (*Lernaeenicus*); and in the case of very oblique boring there may be no bend at all (*Lernaea*, species).

In those parasites whose point of entrance is on the median line of the host this simple flexion of the body seems to be the only result produced. Specimens of all three of the genera mentioned above have been taken by the author from the median line of various hosts, and their bodies showed no torsion whatever. This fact seems to have escaped the observation of Baudouin and Quidor; at least they make no mention of it. But when, as usually occurs, the point of attachment is on the right or the left side of the host, then there follows a torsion or twisting of the body of the parasite upon its long axis in addition to the flexion.

Of course the body may turn either to the left or the right, and Quidor has defined as *direct* that torsion in which the body is turned from the left over toward the right when viewed from the anterior end, and as *inverse* when it turns from the right over toward the left. The amount of torsion is measured by standing the parasite

upon end in a circle so that the long axis of the parasite will, if produced, pass through the center, and at right angles to the plane of the circle. Radii are then drawn through the center of the anal and mouth apertures and projected upon the plane of the circle. The angle between these radii is the angle of torsion and is expressed in degrees. There are almost always longitudinal ridges or stripes or something of the sort which indicate clearly the direction of torsion, whether to the right or left.

So far as observations have gone there seems to be considerable regularity in the torsion, not only as to the direction, but also as to the amount. Furthermore if the torsion of any given species is direct on the right side of the host it is more often inverse on the left side, and the opposite. But the present author is by no means prepared to go as far as Quidor does and say that the kind and amount of torsion possesses specific value. On the contrary both prudence and actual observation strongly prohibit any such conclusion. In view of the extremely meager data at present available it seems presumptuous to assume that two given specimens of any genus are distinct because they were found on the same side of their host, and the one showed direct torsion while in the other it was inverse. And the distinction between a direct torsion of 45° in one specimen and 90° in another possesses still less value.

Subsequent observations may show that such distinctions ought to be considered in connection with certain genera, but the following tables prove conclusively that in the genus *Lernaeenicus* they are not worth considering.

Sixteen tomcod heads were preserved by Mr. V. N. Edwards at Woods Hole, each of which was badly infested on the side of the head, along the margin of the gill covers, and behind the pectoral fins with *Lernaeenicus affixus*, the number of specimens varying from 2 to 24 and the total reaching 138. The direction and amount of torsion of each parasite was carefully noted and is recorded in the tables, together with the position on the host.

It is assumed that in its normal position the dorso-ventral axis of the parasite is at right angles to the surface of the host's body and that the ventral surface of the parasite is next to the skin of the fish. This position is indicated in the tables by the term "dorsal 0°," and shows that there has been no torsion. When the parasite has been turned 180° in either direction its dorsal surface will be next to the skin of the fish, and this position is indicated by the term "ventral 180°." In case of doubt as to the direction of torsion the entire parasite was removed. The tomcod heads are numbered consecutively, the numbers appearing in the first column of the tables.

	Right side.	Center.	Left side.
1	direct..... 90° inverse.... 90°	ventral..... 180° ventral..... 180° dorsal..... 0°	
2	inverse.... 90° direct..... 10° direct..... 60° inverse.... 10° dorsal..... 0° inverse.... 90° inverse.... 30° inverse.... 10° direct..... 90° inverse.... 120° inverse.... 10°	dorsal..... 0°	
3	ventral.... 180° dorsal..... 0°	inverse.... 45° direct..... 45° inverse..... 60°	
4	inverse.... 60°	dorsal..... 0°	inverse.... 45° direct..... 90° dorsal..... 0°
5	inverse.... 45° inverse.... 10°	direct..... 90° inverse..... 45° dorsal..... 0° inverse..... 45°	ventral... 180° inverse.... 100°
6	inverse ... 45° inverse.... 90° inverse.... 135°	direct..... 30°	
7		direct..... 135° inverse..... 45° dorsal..... 0°	inverse.... 90° inverse.... 45°

	Right side.	Center.	Left side.
8	direct..... 90° inverse.... 90° inverse.... 60° direct..... 90°	dorsal..... 0° inverse..... 135° direct..... 135° direct..... 90°	inverse.... 90° direct..... 90° dorsal..... 0° inverse.... 45° dorsal..... 0° inverse.... 90°
9	direct..... 135° dorsal..... 0° inverse.... 90° direct..... 60° inverse.... 135° inverse.... 135° ventral.... 180° inverse.... 100° ventral.... 180°		dorsal..... 0° inverse.... 90° direct..... 45° dorsal..... 0° direct..... 135°
10	direct..... 90° inverse.... 90° ventral.... 180° inverse.... 45° inverse.... 45° inverse.... 45° direct..... 90°	direct..... 90° direct..... 135°	direct..... 45° direct..... 90°
11			direct..... 90° direct..... 90° direct..... 100° inverse.... 45° inverse.... 90° direct..... 90° inverse.... 45° direct..... 90° direct..... 90°
12		inverse..... 90° ventral..... 180° dorsal..... 0°	
13	inverse.... 90°	direct..... 90°	

	Right side.	Center.	Left side.
14		inverse..... 45° direct..... 100°	inverse.... 60° dorsal..... 0° dorsal..... 0° direct..... 45° inverse.... 135°
15	inverse.... 90° inverse.... 90° inverse.... 135° inverse.... 90° direct..... 45° direct..... 90° dorsal..... 0° ventral.... 180°	direct..... 10° ventral..... 180° dorsal..... 0° ventral..... 180° ventral..... 180° direct..... 135° direct..... 90° inverse..... 90° ventral..... 180° ventral..... 180°	ventral.... 180° direct..... 90° direct..... 45° direct..... 45° direct..... 135° ventral.... 180°
16		dorsal..... 0° dorsal..... 0° inverse..... 135° direct..... 90° direct..... 45° inverse..... 90° dorsal..... 0° inverse..... 90° dorsal..... 0°	ventral.... 180°

In these tables there are 50 parasites from the right side of the host, 44 on the median line, and 44 from the left side—a remarkably even distribution. Of the 50 from the right side 29 (57 per cent) showed inverse torsion, 13 (26 per cent) showed direct torsion, and the remaining 8 either showed no torsion or were twisted through 180°. Of the 44 from the left side 19 (44 per cent) showed direct torsion, 14 (32 per cent) showed inverse torsion, and the remaining 11 either showed no torsion or were twisted 180°. Of the 44 from the median line 20 (44 per cent) showed no torsion or were twisted 180°, and the remaining 24 were evenly divided between direct and inverse torsion.

From these tables we may safely draw certain conclusions:

1. In the majority of instances the torsion is inverse on the right side and direct on the left side, but there is altogether too large a minority in each case to warrant us in attaching any specific value to the direction of torsion.

2. On the fifth head the necks of the four parasites from the center all entered the same opening in the skin of the host, and yet one showed no torsion, two showed inverse torsion, and one showed direct torsion.

On the eighth head the first three parasites from the center all entered the same opening in the fish's throat; one of them showed no torsion, while the other two were strongly twisted in opposite directions.

On the ninth head the first three parasites all entered a single opening in the right operculum of the fish, on the eleventh head the first three similarly entered a single opening in the left operculum, and on the fourteenth head the last three also came from one opening. Hence we are forced to the conclusion that the position of the parasite upon its host can not be the chief cause in determining either the direction or the amount of torsion. There must be some other influence so much stronger than the position that it can completely overcome the latter and produce its own effects in spite of opposition.

3. With reference to the amount of torsion four or five successive figures anywhere in the tables will show that for this species it possesses no significance whatever.

But Quidor, in the article already referred to and in another later one, went even further and argued that the genus *Sphyrion*, which has been placed with the Chondracanthidae, and a new genus *Hepatophilus*, which he had just established, should be transferred to the Lernaeidae, because they both showed torsion. He stated that the males of the two genera were unknown, and that the females showed distinct torsion, "which is found only in the Lernaeidae" (p. XL). There can be no question that they show torsion, but such a twisting of the body is merely mechanical, and there is no reason why any fixed parasite should not exhibit it, provided the anterior end of the body is firmly anchored in the flesh of the host while the posterior part hangs free in the water. On the contrary, there is every reason why all such parasites should show torsion quite irrespective of their morphology and ontogeny. But obviously we can not bunch them all in one family on the basis of torsion alone, when there are good morphological and developmental reasons why they should be separated.

With reference to the disposition of the above-mentioned genera and others which have been crowded into the Lernaeidae, a full discussion will be found on page 34.

Causes which produce the torsion.—Quidor stated that "This torsion is the result of the mode of fixation of the parasite, of the habits of the host, and of the mechanical action of the external medium" (1912*c*, p. 87).

We can readily understand how the resistance offered by the water produces both flexion and torsion in the body of the parasite, and how the amount of each might be varied by the habits of the host. But neither of these causes explains the differences enumerated in the above tables, especially the different kinds and amounts of torsion in specimens attached at the same point and on the same host. Again we are forced to the conclusion that there must be another cause, stronger than any of those already mentioned. Quidor did not explain what he meant by the "mode of fixation of the parasite," but rightly interpreted this evidently becomes the controlling cause, and is worthy of careful consideration.

First comes the choice of a location on the body of the host; some genera choose the gills or gill chamber, while others select some place on the outside of the fish's body, a few species even preferring the eye.

Attention has been elsewhere called to the burrowing of the parasite into the tissues of the host, which varies greatly according to the locality selected. In the throat it is only a short distance from the outside surface or from the gill arches to the ventral aorta or to the heart, and it is an easy matter for the parasite to find those blood vessels.

From the back or the sides of the fish it is a much greater distance, varying with the size of the fish, and the parasite, after burrowing through the tissues, will be fortunate if it strikes at once the blood vessel that it started for. Then, too, the knowledge of the fish's anatomy possessed by the parasite is not infallible, and it frequently happens that the burrow strikes a rib or the backbone, around which it must turn before reaching the desired goal. In such a case the parasite may have to hunt around for some little distance before it finds the blood supply. This turning aside of the anterior end of the body and the adjusting of the mouth to the blood supply is what produces the torsion. Jungerson told (1911, p. 7) of a young *Sarcotretes scopeli* fixed on the back of its host on a line with the root of the pectoral fin. "It went nearly straight down through the muscles, curved in front of the right pronephros over the upper pharyngeal bones, and had its anterior end lying in front of the left pronephros, with the sucking apparatus close to the jugular vein." Such a twisting of the anterior part of the body would have produced torsion even if there had been no external resistance.

Similarly, Baudouin described the mode of fixation of *Lernaeenicus sardinae*, in the back of the sardine near the dorsal fin: "The cephalothorax buries itself almost perpendicularly to the axis of

the body of the sardine, and crosses over in the midst of the muscles to the lateral portion of the vertebral column, going along one of the faces of the series of spinous hypophyses to a distance of about 1 cm" (1905, p. 326).

Here the cephalothorax seems to be able to cling to the bony framework, as a woodpecker clings to a tree, and in order to do this the cephalothorax must be definitely adjusted to the framework. The crossing over to the hypophysis and the adjusting of the cephalothorax again produce torsion.

In the case of *Pennella* on the swordfish there is a more marked twisting about before the final adjustment. The distance to be penetrated through the flesh is always several inches, and it seldom happens that the parasite gets very near to a blood vessel at first. Like the sardine Lernaean it starts perpendicularly to the axis of the fish's body, but often meets some obstruction around which it must turn aside. And when it has reached the body cavity it is compelled to move backward or forward, to the right or to the left before it can find a suitable food supply.

The result is that the head and neck of the *Pennella* is often twisted in corkscrew fashion or even thrown into a coil inside of the enormous cyst. The author has two of these cysts, taken from a 200-pound swordfish, in one of which the cephalothorax of the parasite describes a complete circle, 1½ inches in diameter, while in the other it takes the form of an ellipse 1¾ by 2¼ inches.

Such a coiling of the cephalothorax and neck must be accompanied by a considerable torsion of the body, and would very easily overcome the external resistance of the water. We are forced, therefore, to the conclusion that the real cause of torsion is internal, inside the tissues of the host, and not external. In the fresh-water genus *Lernaea* it sometimes happens that the torsion accidentally proceeds much farther than usual. Thus one specimen showed a direct torsion of 315°, or seven-eighths of a complete revolution, while another showed four complete revolutions, 1,440°.

Food.—Whatever may be the case with parasites of other families there can be no doubt that these Lernaeidae feed upon the blood of their host.

The simple fact that they burrow through the flesh until their head and mouth are brought into close proximity with some large blood vessel, and sometimes penetrate into the heart itself, leaves us no choice but to conclude that the parasite is making sure of a copious food supply. During the first free-swimming period the larvae of both sexes may, and probably do, obtain food from the plankton like other copepod larvae. But during the parasitism which follows this free-swimming period it is just as probable that

they feed upon the blood of their temporary host. Upon this food the various appendages develop and the sexes reach maturity. The male undergoes no further change and usually remains parasitic upon this first host. A few males, however, sometimes join the females for the second free-swimming period, but it is highly improbable that either sex takes any plankton food during this period. Their mouth parts are only suited for obtaining food parasitically. The male has completed his life work, he does not increase at all in size, and dies in a very short time.

The female is seeking a final host, to which she fastens as soon as it is found, and the copious supply of blood obtained from this host seems to be necessary for the formation and ripening of the eggs. No females of any genus produce egg strings until after this final food supply has been secured. The female does not increase in size during this period nor undergo any other changes, but awaits for a suitable food supply.

Hosts.—This family, like the Lernaeopodidae, is found upon fishes in both salt and fresh water. In consequence of the fact that the first or temporary host is always a different species from the final one, the number of hosts is greatly increased. We find these parasites also upon fishes at all depths from near the surface down to 2,000 fathoms and over.

Lernaeocera seems to prefer the gills of the Gadidae for a final host and the gills of the Pleuronectidae for a temporary host; *Lernaeolophus* is found upon the gills of the parrot fish, the barracuda, and the groupers of tropical seas; *Peroderma* often frequents the lateral muscles of the sardine, the goby, and Cuvier's genus *Scopelus* as its host; *Pennella* for its final host burrows deeply into the swordfish, the tunny, the sunfish, the dolphin, and the flying fish; *Peniculus* is found upon the fins of the Gadidae; *Lernaeenicus* penetrates the flesh of the Mugilidae, the Clupeidae, the dolphin, and the barracuda; *Lernaea* chooses the gars and pike perches for its temporary host, and the basses, the catfish, and the carp for its final host.

Parasites.—The Lernaeidae are notable examples of the fact that one parasite often serves as the host for another. Many of them are attached to the outside of the body of the fish, where they can catch all that floats in the water, and they very quickly become covered with algae, ciliate infusoria, hydroids, and even barnacles (fig. 147). The striped goose barnacle, *Conchoderma virgatum*, has been found upon several species of *Pennella*, and Fowler, in his Report on the Crustacea of New Jersey (1912, p. 91), stated that many of the specimens of *Pennella filosa* were parasitized with this barnacle and with the hydroid *Eucope parasitica*.

Other Lernaeans from both salt and fresh water are often so covered by algae that it is difficult to see any portion of the para-

site's body. Jungersen (1911, p. 1) found the external portion of the body of the new copepod which he described completely covered with a gymnoblastic hydroid, so that "the parasite at first sight appears made up of a stem and a large number of branchlets," the latter being the hydroids.

Kellicott (1880, p. 66), in speaking of the adult *Lernaea cruciata*, said that "the chitinous exterior, together with the external load of confervae and infusorial life which they usually bear, render them too opaque for satisfactory examination."

Cunnington (1914, p. 827), in his remarks upon *Lernaea haplocephala*, a new species from the ganoid fish, *Polypterus*, taken in Lake Tanganyika and the White Nile in Africa, said: "Vorticellids infest many of these Lernaeids from the Nile to such a degree as to render difficult the study of their anatomy. Among a considerable number of specimens taken on a *Polypterus senegalis* almost all are infested, some of them as markedly as the one photographed (fig. 7). The region where the vorticellids are most thickly attached is about the junction of the thin anterior third of the body with the more dilated posterior portion. It seems highly probable that the manner in which these parasitic copepods can be so densely encrusted by such organisms is directly related to the peculiar fact that after fixation to their host they appear no longer to undergo ecdysis."

Jungersen also mentioned several other examples of triple association between a hydroid, a parasitic copepod, and a fish. He himself had seen *Obelia geniculata* "flourishing on a *Lernaea*[1] *branchialis* attached in the gills of the common cod; a similar case is mentioned by Saemundsson" (p. 28).

Alexander Agassiz (1865, p. 87) found the hydroid *Eucope parasitica* "on a species of *Pennella* parasitic on *Orthagoriscus mola*." Later the same hydroid was taken by Leidy (1889, p. 165) on another Lernaean, "*Lerneonema*[2] *procera*," parasitic on *Odontaspis littoralis*."

Many of the specimens of *Lernaeenicus longiventris* and *L. radiatus* in the United States National Museum collection are well covered with hydroids and algae.

Ciliate infusoria are also often attached to *Pennella* and *Lernaeenicus*, sometimes in company with algae, sometimes alone. The Lernaeans which fasten to the gills or on the inside of the gill chamber for the most part escape these Epizoans, but specimens of *Lernaeolophus* and *Haemobaphes* are occasionally obtained with algae fastened to the posterior processes or the abdomen. Indeed *Peniculus* is the only genus upon which none of these forms have been recorded, and this is probably an omission.

[1] A synonym of *Lernaeocera branchialis*.
[2] A synonym of *Lernaeenicus procerus*.

Among them all there has not yet been found a true superparasite. They are merely inquilines; that is, none of them use the copepods for anything further than a means of anchorage or support. They all provide their own food, and they neither give anything to nor take anything from the copepods. The food which they take from the water can not affect the copepod in any way, since the latter is sucking the blood of the fish.

The only influence they can have is a mechanical one, loading the copepod down with a comparatively heavy weight, and increasing considerably the surface of water resistance.

If they are distributed evenly over the copepod's body they do not affect the torsion, but if there is only a single goose barnacle, or tuft of algae, or colony of hydroids, they must of necessity have more or less influence on torsion according to their position.

EXTERNAL MORPHOLOGY.

General body form of adult female.—During the copepodid stages when fertilization takes place the different body regions are as clearly defined as in the Caligidae. Indeed these stages show such a marked likeness to the corresponding ones in the Caligidae as to leave us in no doubt of the close relationship of the two. But as soon as the female has fixed herself to her final host a retrogressive metamorphosis begins. Horns or processes begin to develop on the sides of the cephalothorax and sometimes (*Pennella*, *Cardiodectes*, *Peroderma*) over the anterior end. In *Peniculus*, *Phrixocephalus*, and *Collipravus* the anterior thoracic segments remain fairly distinct and each carries a pair of swimming legs. In *Lernaea* while the segments are fused the swimming legs remain separated by a considerable distance and still indicate the thoracic divisions. In the other genera the swimming legs are bunched together close behind the head and there is a corresponding fusion of the thorax segments. The antennae do not increase in size with the growth of the rest of the body, but remain minute, and the same is true of the swimming legs; the eyes are buried by the growth of new tissue over them and become invisible, and in some genera (*Pennella*, *Lernaeolophus*) the mouth parts disappear or are possibly represented by small chitin knobs.

In general, therefore, the body of the Lernaean is unsegmented, but may be more or less distinctly separated into three parts—a cephalothorax made up of the head and one or two anterior thorax segments, a neck or free thorax, and a swollen posterior portion or trunk, consisting of the fused genital segment and abdomen.

In *Phrixocephalus* the first two thorax segments are fused with the head; in other genera only the first one. The resulting cephalothorax is globular in *Lernaeocera*, *Pennella*, and *Lernaeolophus*, while it is more or less flattened dorso-ventrally in *Peniculus*, *Ler-*

naeenicus, and *Lernaea;* and in *Peroderma* it is conical. Furthermore, in this latter genus the head and neck are attached at right angles to the trunk, while in other genera the head alone stands at an angle with the neck.

In *Pennella* the anterior surface and often the entire cephalothorax is covered with small globular or irregular processes which help to anchor the parasite firmly in position. In *Peroderma* and *Cardiodectes* branched processes are developed from the front of the head alone, while in *Phrixocephalus* these anterior processes take the form of small lobed and chitinous horns.

Again in most of the genera processes, flattened dorso-ventrally, are sent out from the lateral and sometimes from the dorsal margins of the head and anterior thorax segment. These afterwards develop into horns, which complete the anchorage of the parasite to its host.

There are no horns on *Peniculus*, *Haemobaphes*, *Cardiodectes*, or *Peroderma*, the anchorage being accomplished by the strong claws on the second antennae, by the frontal processes, or by a flexure of the neck.

In *Lernaeocera* and *Lernaeolophus* the horns are well developed and often branched dichotomously; in the other genera they are nearly always simple.

These horns are outgrowths of the epidermal tissues and at first are short and wide and soft in texture; subsequently they elongate, become more or less cylindrical, and are gradually hardened into chitin.

Too much systematic value must not be given either to the number or the arrangement of the horns in any genus or species, although a certain number and arrangement may be typical in each species; for example, the five radiating horns in *Lernaeenicus radiatus*. But there is always so much variation that no dependence can be placed upon negative evidence; positive evidence is more conclusive. No specimen of any other species has thus far been found which possesses five horns radiately arranged, but there are many specimens of *Lernaeenicus radiatus* which do not show them. The number and arrangement of the horns depend more upon the difficulties encountered by the parasite in attaching itself to its host, and upon the kind of configuration of the tissue of the host surrounding the point of attachment, than upon any specific inheritance in the parasite itself. When the head of *L. radiatus* is buried in the muscles of the menhaden there is no trouble in developing five radiating horns, but the result is very different when the head is wedged between two of the bony plates of the operculum. The horns, therefore, must be given an insignificant place in the determination of the species, and it would be extremely rash to establish a new genus simply upon the possession of two extra horns, as Fowler has done.

The neck or free thorax is usually cylindrical and much narrower than the other two regions; it is sometimes straight (*Lernaeenicus* and *Lernaea*) and sometimes flexed (*Lernaeolophus* and *Haemobaphes*).

In *Peniculus* it is short and flattened dorsoventrally, while in some species of *Pennella* it is 100 mm. or more in length. Its length is largely determined by the thickness of the skin and underlying tissue that must be penetrated in order to bring the mouth of the parasite into close contact with some large blood vessel. Even the same species will have a longer neck on a thick-skinned and thick-muscled fish like the sunfish and a shorter neck on a thinner-skinned and thinner-muscled fish like the swordfish. The neck often becomes hardened into chitin like the horns and is always much firmer in texture than the following region, especially at the point where it emerges from the skin of the host.

Usually it is not segmented, the moniliform appearance of such species as *Lernaeenicus sprattae* being something very distinct from segmentation.

In *Lernaea* the neck and body are the same width where they come together, and the point of union is indistinguishable; but the segments are indicated by the attachment of the swimming legs. From these it can readily be seen that all the thorax segments have shared in the elongation of the body. In *Peniculus* the neck is very much narrower than the body, where the two come together, and is distinctly segmented, with a pair of legs attached to each segment. These show us that while all the thorax segments share in the elongation of the body the size of the shares increases rapidly from in front backwards.

In *Lernaeocera* and *Pennella* the swimming legs are found at the anterior end of the neck, packed together as closely as possible just behind the head. This may possibly be a real migration in some of the genera—that is, the legs may have moved from the segment where they originally appeared onto preceding segments, as happens to the maxillipeds in the Lernaeopodidae. But the lengthening of the genital segment during the second free-swimming larval period indicates that the anterior thorax segments contribute very little to the neck and that the great bulk of the latter is made up of the anterior end of the fused fifth and genital segments.

The swollen trunk is made up of the fifth and genital segments and the abdomen, and is much softer in texture than the preceding regions. It is usually greatly elongated as well as swollen, but is rarely short and stout. In *Lernaeocera* and its close relatives it is also convoluted or bent in the form of the letter S. The abdomen is the portion behind the attachment of the egg strings, it is always

narrower than the genital segment, and is often reduced to a mere knob. To this abdomen are attached various kinds of appendages in some of the genera. In *Pennella* and *Pegesimallus* there are very long rows of branched barbules, from which the former and better known genus derives its name. In *Lernaeolophus* there are similar appendages massed together closely, so that they bear more resemblance to a yarn mop than to the barbules of a feather. In *Haemobaphes* and *Haemobaphoides* there are two or three large knobs or processes along either side. In the other genera the abdomen is without appendages.

The egg strings vary greatly in the different genera, not only in their general makeup, but also in the arrangement of the eggs inside the string. In the Lernaeinae the cases are sacklike and the eggs are multiseriate; in all the other genera the cases are threadlike and the eggs are uniseriate. The multiseriate egg strings are shorter than the body and straight, while the uniseriate egg strings are often many times the length of the body, and are either cylindrical and straight, or coiled into a loose snarl, or flattened laterally and curled into a tight spiral.

The appendages.—These are the same as those of the Lernaeopodidae, namely, two pairs of antennae, a pair of mandibles, two pairs of maxillae, a pair of maxillipeds, and four or five pairs of swimming legs. These are all present in the sexually ripe male, but some of them are usually wanting in the female.

The first or anterior antennae are simple jointed cylinders, well armed with short setae, and are evidently tactile sense organs. The second or posterior antennae are also simple jointed cylinders, short, stout, and strongly chelate. They serve as the principal organs of prehension during the larval stages and often maintain that function in the matured female (*Peniculus*, etc.).

The proboscis is made up of a fusion of the upper and under lips, often combined with a considerable portion of the ventral surface of the head.

In this latter form it is very extensile and may be protruded a considerable distance from the head and moved about freely, the movements being controlled by numerous powerful muscles. When strongly retracted, as sometimes happens during preservation, it is drawn in so far as to produce a saucer-shaped or bowl-shaped depression of the ventral surface of the head. When protracted the maxillae are carried along with it and are then found near the tip of the proboscis, a considerable distance from the ventral surface of the head. In those genera (*Lernaeolophus*) where the ventral surface of the head is chitinized and takes no part in the movements of the mouth tube, the latter is always withdrawn in preservation

and forms a pit or shallow depression. In *Haemobaphes* the proboscis is apparently confined to the mouth tube proper and the maxallae are attached to the ventral surface of the head at its base.

The mandibles are simply curved claws or spines, one-jointed and entirely devoid of teeth. The first maxillae are also one-jointed and armed with short setae; the second maxillae are two or three jointed and terminate in one or two stout claws. There is also usually a stout spine on the inner or outer margin of the basal joint. These appendages are important organs of prehension in the copepodid larvae, and doubtless assist in the burrowing of the female into the flesh of her final host.

The maxillipeds are found in both sexes of *Lernaea*, but so far as known only in the males of other genera, and are made up of a large swollen basal joint, a smaller distal joint, and from one to five terminal claws.

The swimming legs, as Claus pointed out, do not increase in size from the larval condition and, therefore, appear rudimentary and degenerate upon the greatly enlarged body of the adult. There is, however, no actual degeneration or retrogression in their structure, but it often, perhaps usually, happens that the rami or even the entire legs get broken off. This may result either from the movements of the parasite itself or during its removal from its host and subsequent separation from the cyst which envelops it. But in such cases there is always left the scar at either end of the chitin rib which connected the legs or the stumps of the rami. We can not, therefore, regard the swimming legs as having actually degenerated or retrogressed, but simply as having failed to increase in size with the rest of the body. And we must not conclude from an examination of one or two specimens that the legs are destitute of rami, when further search will likely yield a specimen on which they are still retained.

In general we may say that the genus *Lernaea* possesses five pairs of swimming legs, of which the first four pairs are biramose with three-jointed rami, while the fifth pair is uniramose and unsegmented.

In most of the other genera there are but four pairs, even in the larval form—the first two pairs biramose, the third and fourth pairs uniramose, all the rami two-jointed. In *Peroderma* and *Sarcotretes* there are but three pairs—the first two pairs biramose, the third pair uniramose, and all the rami two-jointed. In *Haemobaphoides* there are only two pairs of legs, both biramose with two-jointed rami.

The copepodid larvae of *Sarcotretes* possess only three pairs of swimming legs in contrast to the four pairs found in the larvae of *Lernaeocera* and *Pennella*, and the five pairs in the larvae of *Lernaea*.

It will be of great interest to find the larvae of *Peroderma* and *Haemobaphoides* and ascertain if they also show a reduction in the number of legs, the latter genus having only two pairs.

INTERNAL MORPHOLOGY.

The body wall.—The body wall is composed of two layers—an outer transparent layer, which may or may not become chitinous, and an inner opaque and cellular layer, the chitinogen membrane of Claus and other authors.

The outer layer is made up of thin lamellae, lying one upon another, with no intervening spaces. In *Lernaea barnimii* Hartmann described quite a complicated pattern of raised sculpture on the external surface of the outer layer. This may be seen on fresh and living specimens but usually disappears during preservation. Through this outer layer run pore canals, which vary in proximity in different parts of the body, being closest together along the center of the body and farthest apart on the antennae, swimming legs, and furca. These canals are connected more or less intimately with the soft inner layer of the wall and probably function in excretion.

The inner layer of the body wall is softer than the outer and is never hardened into chitin. It is composed of polyhedral cells, which vary greatly in thickness, those lining the posterior body and abdomen being much thicker than those found in the anterior body and arms. The cells are not much flattened but are more or less inflated and filled with a fine-grained brownish substance, glandular in nature, and having spherical nuclei with small nucleoli. This layer normally lies in contact with the inside surface of the outer layer, but in alcoholic specimens the two layers are often separated. In the living animal the cells of the inner layer undergo certain changes, thus described by Hartmann: "Some cells break loose, stretch out, become narrower, take on the appearance of threads, anastomose with one another, and send out many irregular processes" (p. 736). This wandering of the cells takes place in all parts of the body, in the horns, and in the appendages. As a result they form a meshwork of active protoplasm over the inside surface of the inner layer and fill such spaces as the inside of the abdomen around the intestine.

This meshwork is particularly thick inside the posterior body of the copepodid larva and probably contributes greatly to the nourishment and increase of that part of the body during its rapid development.

The muscular system.—In the copepodid stages the muscular system is well developed and very closely resembles that of the Caligidae, thus furnishing another evidence of the close relationship of the two families. But as soon as the female has fastened herself to her final

host and has begun her retrogressive metamorphosis the muscles share in the changes produced. As the body fuses and becomes swollen and tumid and the appendages cease to be used the muscles also fuse and disappear until there is nothing left in the adult female but a simple network between the integument and the alimentary canal to be noted under the digestive system (p. 27).

There are still the usual muscles connected with the antennae, especially the second pair, with such of the mouth parts as are still used, with the swimming legs of those genera in which they are better preserved, and with the anal papillae in *Lernaea*, *Peniculus*, etc., and in even the most retrogressive genera there are still muscles connected with the external openings of the oviducts, which control the passage of the eggs into the external sacks. But the other muscles, including all those which flexed or moved the body of the copepodid larva, entirely disappear. In *Lernaeenicus* the proboscis is highly developed and possesses a complicated system of muscles whereby each part of it, as well as the mouth parts connected with it, can be moved independently.

But the swimming legs are less well preserved and their musculature is correspondingly reduced. In *Peniculus* the jointed thorax retains more or less of its capability of motion, and with this most of the muscles.

The alimentary canal.—The mouth opens into a short esophagus, which is usually straight or but slightly curved, and is inclined to the axis of the head. It opens into the stomach on the ventral surface of the latter, near or at the anterior end, and the opening is guarded by a powerful sphincter muscle. In those genera (*Lernaeenicus*, *Peniculus*, etc.) in which there is a protrusible proboscis the extension and retraction take place principally in the mouth tube, and are shared only incidentally by the esophagus and at its anterior end. The muscles, which control these movements, are attached chiefly to the base of the mouth tube (fig. 69) and draw it in or push it out without affecting the esophagus very much.

When the proboscis is protruded the stomach is drawn forward by the muscles at its anterior end, and this shifts the position of the esophagus and allows it to follow the movement of the mouth tube without itself undergoing much change of length or diameter. Its walls, however, are elastic and are probably stretched a little during the extension of the proboscis and recover their normal form when it is retracted.

The stomach is abruptly enlarged behind the sphincter muscle and is sometimes straight and sometimes convoluted. In the genus *Lernaea* it also sends out a lobe on either side, but these lobes are not connected in any way with the horns, nor can they be said to enter the base of the horns, as Claus, Hartmann, and some others have

declared. There are always two of them, no matter what the number of the horns may be, and sometimes they are not opposite the base of the horns. Furthermore, they are present in the larva long before the horns have started to grow. The stomach is lined with a digestive epithelium of very irregular thickness, from which scattering spherical cells project into the central cavity. These contain the digestive fluids and also a large nucleus with distinct nucleoli.

The stomach passes insensibly into the intestine, which, in most of the genera, is narrowed to a mere thread where it passes through the neck and then widens again in the trunk. Sometimes (*Lernaeolophus*) the intestine is convoluted in the lower portion of the neck, but it is usually straight. In the trunk it lies nearer the dorsal surface, between the ovaries and the oviduct, and is sometimes flattened dorsoventrally (*Sarcotretes*), again laterally (*Lernaeolophus*), or may even assume a three-cornered shape (*Pennella tridentata*), but is usually cylindrical.

In species like *Phrixocephalus triangulus*, where the trunk is short and wide, the intestine becomes baglike, and in the new genus *Collipravus* it is looped and folded back on itself, owing to the misplacement of the neck. The intestine passes into the abdomen in those genera (*Lernaeolophus*, *Pennella*, etc.) which have a comparatively large abdomen, and is bluntly rounded near the posterior end of the latter. In the genera (*Sarcotretes*, *Peniculus*, etc.) with a small abdomen it does not leave the trunk, but is bluntly rounded just in front of the vulvae, and the rectum is given off from its upper posterior corner. The rectum is very narrow and threadlike, and is connected with the side walls of the abdomen by numerous muscles. It is straight when the abdomen is large, but in the other genera is inclined dorsally.

In every genus thus far examined there is an anal lamina on either side of the external opening of the rectum, sometimes fair sized and armed with setae, sometimes minute and destitute of setae. But no matter how small the lamina may be there is an opening through the body wall into its interior that shows its real nature (fig. 57).

The anterior end of the stomach is suspended from the dorsal wall of the head by two long and narrow muscles, and in the genus *Lernaea* there are additional sets of muscles on each of the lateral lobes. The posterior end of the intestine is similarly connected with the dorsal wall of the abdomen or trunk. The alternate contraction and expansion of these muscles produce a forward and backward movement of the entire digestive canal. This is most marked in the copepodid larvae, but persists to some extent in those adults whose bodies are straight and not bent into a sigmoid loop. In addition to these

muscles the digestive canal is suspended by connective tissue from the dorsal or lateral walls of the various regions of the body through which it passes.

The walls of the stomach and intestine also contain both longitudinal and transverse muscle fibers, which produce strong peristaltic movements, so that the food is moved about and pushed back and forth over every portion of the digestive epithelium.

The nervous system.—The copepodid larva has a nervous system almost the same as that of the Caligidae, which has been described in detail elsewhere; but, like the muscular system, this, too, gradually disappears, and but little of it can be found in the adult female. There is enough of it left, however, to control such movements as persist, and especially the working of the reproductive organs.

In a median section of the head (fig. 69) the remains of the supra and the infra esophageal ganglia can still be seen, with scattered nuclei representing the nerve centers. Even the nerves themselves may be detected, but only those leading to muscles and organs which are active in the adult. Of the other nerves and even of the ventral chain of ganglia only traces are left, which are difficult to detect.

In all the genera the tripartite eye of the larva persists in the adult, and there is usually a more or less distinct nerve connecting it with the supra-esophageal ganglion. But it is buried deeply in the tissues over the base of the esophagus and has evidently been covered with the surrounding tissues during the growth of the various horns and cephalic processes. The lenses are usually no longer visible and, indeed, the eye itself can not be seen except in specimens which have been cleared in oil or some similar medium. The nervous system, therefore, shows the greatest retrogression of any portion of the body; it not only fails to increase proportionally to the growth of the body, like the various appendages, but it really diminishes and partially disappears.

The male reproductive organs.—The male reaches sexual maturity during the fourth copepodid stage, and the sex organs consist of a pair of testes situated in the posterior part of the cephalothorax and separated some little distance from each other, a pair of straight vasa deferentia, and a pair of sperm receptacles, containing the spermatophores and located in the genital segment. Each testis is an ovoid or ellipsoid and is somewhat flattened dorsoventrally; the vas deferens leads from the testis directly back alongside the intestine and into the genital segment, where it is enlarged into a receptacle to hold the spermatophores. In the fifth segment the vas deferens is convoluted once, and this fold has glandular walls which supply the cement material for the outside covering of the spermatophores. The opening through which the latter are extruded is on the ventral surface of the genital segment.

The female reproductive organs.—In the copepodid stage, when fertilization takes place, the ovaries of the female are ovoids or ellipsoids, like the testes of the male, and are similarly situated in the posterior portion of the cephalothorax, near the dorsal surface. The oviducts correspond in every particular with the vasa deferentia, leading back alongside the intestine to an enlargement in the genital segment, which is to receive the sperms from the spermatophores deposited on the outside of the segment by the male; and in the genus *Lernaea* the posterior portion of the oviduct secretes cement substance, like the vasa deferentia.

During the retrogressive metamorphosis which follows the fixation of the female to her final host a great change takes place in both the location and structure of the reproductive organs. The ovary migrates from the cephalothorax through the entire length of the free thorax into the genital segment, where it assumes a position near the dorsal surface at the anterior end of the segment, except in the new genus *Collipravus*, where it is near the posterior end at the base of the abdomen. In most of the genera the ovary also reverses its position, the anterior end becoming posterior and the posterior end anterior, so that the oviducts in the adult always arise from the anterior end. Furthermore, in some genera (*Lernaeocera*, *Pennella*, etc.) the two ovaries move inward toward the midline and finally come together and fuse, leaving only a pair of anterior and posterior horns to mark their dual origin.

The oviducts now pass down around the intestine to the ventral surface and strait back to the vulvae without convolutions, except in *Pennella*, where there is a single fold just as they leave the ovaries.

A pair of cement glands is also formed, whose anterior glandular portion originates at the anterior end of the genital segment at the base of the neck and ventral to the oviducts. Each gland is cylindrical and without convolutions, and the two lie side by side along the midline. At about its center each gland is contracted and passes into a duct which empties into the oviduct of the same side just inside the vulva. These ducts are also without convolutions in all the genera except *Lernaeolophus* and *Lernaeocera*, in which they are vertically convoluted.

In the genus *Lernaea* the cells at the posterior end of the ovary gradually loosen themselves from the epithelium and become associated in longer or shorter filaments or strings, each of which is made up of many cells flattened together like a row of coins and which increase in size toward the anterior end of the ovary and there break up into separate eggs as they pass into the oviducts, the conditions being thus similar to those found in the Lernaeopodidae.

In all the other genera thus far studied the ovary consists of a mass of tiny nucleated cells, with no arrangement into filaments or

strings but with all the eggs separate and in close contact one with another. Those near the opening of the oviduct are about twice the size of those at the center and these in turn are much larger than those at the posterior end. The increase in size is accomplished by the absorption of food material or yolk, which goes on with much greater rapidity at the anterior end just as the eggs pass out into the oviducts. In the latter the eggs are arranged in a single row and are strongly flattened, so that they look like coins standing on edge.

The external egg sacks are short and bag-shaped in the Lernaeinae, and the eggs are piled loosely into them, with almost no flattening and without definite arrangement. In the oviducts also of this subfamily the eggs are spherical instead of being flattened, and they do not quite touch one another. In the other genera the egg sacks are filiform and very long, reaching 12 to 15 inches in the genus *Pennella*, and the eggs are arranged in a single row and flattened as they were in the oviducts; but there is this difference: In the oviducts the eggs are in actual contact, while here in the external sacks each is separated from its neighbor on either side by a partition formed of the egg membranes.

In the Lernaeinae the developing larvae are not arranged in any order with reference to the walls of the egg sacks, but in the other subfamilies there is the same arrangement as in the Caligidae—namely, the body of the nauplius appears on one of the flattened sides of the egg, with the head on the edge of the egg that is nearest the outer lateral margin of the sack. The long axes of the nauplii are usually parallel, but occasionally one is reversed in position; and, similarly, while most of the nauplii are on the proximal surface of each egg, occasionally one will be found on the distal surface.

Fertilization, as already stated, occurs during the last copepodid stage; the spermatophores are attached by the male in pairs to the ventral surface of the genital segment of the female, their openings being brought into contact with the vulvae. The contents of the spermatophore then pass into the enlarged end of the oviduct inside the vulva and the emptied sack drops off. According to A. Scott in *Lernaeocera branchialis* the first pair of spermatophores are replaced by others in succession until the receptacula are filled, each receptaculum holding the contents of four spermatophores. At first the four lots remain separate in the oviduct, but they soon mix and become one homogeneous mass.

A. Scott concluded that in *Lernaeocera* "the spermatozoa at once pass up the rudimentary oviduct to the ovary and fertilize the eggs." (1901, p. 43.) But there are several considerations which render such an action highly improbable:

1. The eggs are not ripe at the time the spermatozoa are introduced into the oviduct, and it requires at least four to six weeks for them to reach maturity. It is hardly possible for an egg to be fertilized so long before it is fully developed.

2. Segmentation does not begin until the eggs pass out into the external sacks; consequently if they were fertilized in the copepodid stage they must then lie dormant during the four to six weeks before they could begin to segment—an extremely improbable procedure.

3. If the spermatozoa swarmed up the rudimentary oviduct they would go in sufficient numbers to fertilize every egg and leave a considerable surplus.

We could hardly concede to the spermatozoa that were left after fertilization the ability to pass back down the oviduct, and they would have to remain in the ovary; but an ovary filled with dead spermatozoa, or for that matter with living ones, would hardly be a favorable place for egg development.

4. The fact that no sperm receptacle can be definitely made out in the adult is what would naturally be expected. It has already been stated that the spermatozoa pass out of the spermatophores into the enlarged end of the oviduct when the copepodid female is fertilized. There is never, therefore, any separate sperm receptacle and none ought to be expected in the adult. Again, this enlarged end of the oviduct in a larva only 1 or 2 millimeters in length is of necessity very small, and it could easily persist in the adult and still escape detection.

In every genus examined there are convolutions in the oviduct, where it is narrowed before passing out of the vulva, that are posterior to the last egg. Any one of these convolutions is large enough to hold several sperm receptacles the size of the one in the copepodid larva, and it would seem more reasonable to conclude that one of them serves such a purpose.

5. But we are not confined wholly to negative evidence. In a young *Pennella filosa*, examined by the present author, the ovaries have already migrated from the cephalothorax into the genital segment, although the larva was only 18 mm. in length. But at the posterior end of this segment, a short distance inside of the vulvæ, there is an enlargement in each oviduct filled with a mass of something that has every appearance of being spermatozoa. This specimen could not be sectioned to complete the proof, but there would seem to be but little doubt that this is the same enlargement into which the spermatozoa were originally introduced, and, if so, they did not pass up into the ovary.

Consequently we can only conclude that the spermatozoa remain near the vulva, and that each egg is fertilized not in the ovary

when it is immature but after it has acquired its yolk material and become fully ripe, just before it passes out into the external sack.

SYSTEMATIC TREATMENT.

Family LERNAEIDAE.

Family characters of female.—The largest of the parasitic copepods, sometimes reaching a length of 200 to 250 mm., exclusive of the egg strings. Body more or less cylindrical, elongate, and unsegmented; separable into three regions—a cephalothorax furnished with horns or processes, a free thorax in the form of a narrow cylindrical neck, and a trunk comprising the rest of the body, more or less swollen and either straight or sigmoid; anal laminae present but often minute; egg strings paired, either short club-shaped sacks or long threads, straight, coiled into loose masses, or twisted into regular spirals. Antennae distinctly dorsal, second pair chelate; mouth in the form of a sucking tube, more or less protrusible; a tripartite eye buried in the tissues above the esophagus; mandibles and two pairs of maxillae, but no maxillipeds except in *Lernaea;* three, four, or five pairs of swimming legs; at least the first two pairs biramose, rami two or three jointed, the others uniramose with jointed rami.

Adult female with the head and part of the neck buried in the tissues of the host and firmly anchored in such a way as to bring the mouth in contact with some copious blood supply.

Family characters of male.—Not developed beyond the fourth copepodid stage, at which time it becomes sexually mature. Body like that of *Cyclops*, comprising a cephalothorax covered dorsally with a carapace, a free thorax, a genital segment, and a jointed abdomen armed with a pair of large anal laminae; antennae and mouth parts like those of the female; proboscis also more or less protrusible; sometimes a sixth pair of rudimentary legs on the genital segment; a pair of large prehensile maxillipeds a little distance behind the mouth tube.

The male never bores into the tissues of its host nor becomes permanently anchored in any way, nor is it ever found attached to or in company with the adult female.

KEY TO THE SUBFAMILIES AND GENERA.

1. Trunk straight; swimming legs widely separated, the posterior pair close to the vulvae; egg cases sacklike; eggs multiseriate ..... *Lernaeinae* 2
1. Trunk straight; first two pairs of swimming legs close together and near the head, the others at short intervals; egg cases filiform and straight or coiled into regular spirals; eggs uniseriate ..... *Lernaeenicinae* 3
1. Trunk with sigmoid curve; all the swimming legs close together and near the head; egg cases filiform and convolute or coiled into spirals; eggs uniseriate and very numerous ..... *Lernaeocerinae* 8

1. Trunk straight; all the swimming legs close together and near the head; egg cases filiform, straight, and very long; eggs uniseriate; abdomen with a row of feather-like processes on either side_____*Pennellinae* 11
2. Head with 2, 3, or 4 soft and swollen horns symmetrically arranged; neck and trunk smooth and without transverse grooves, the one passing gradually into the other_____*Lernaea* Linnaeus, 1758, p. 36.
2. Head with irregular protuberances; neck and trunk transversely wrinkled, the one passing into the other abruptly with a great difference in diameter_____*Leptotrachelus* Brian, 1903, p. 40.
2. Dorsal portion of head extended straight forward, longer than the body, and bearing on its swollen tip the antennae; head and trunk the same diameter without a neck_____*Therodamus* Krøyer, 1863, p. 41.
3. Head and thorax smooth, without processes or horns, and in line with the axis of the trunk_____*Peniculus* Nordmann, 1832, p. 44.
3. Cephalothorax with horns or processes, or both, and often bent at an angle with the neck_____ 4
4. Bilateral symmetry perfect; branched frontal processes covering the anterior head, but no horns or lateral processes; egg strings straight_____ 5
4. Bilateral symmetry perfect; lateral horns or cushion-like processes, but no frontal processes; egg strings straight_____ 6
4. Bilateral symmetry considerably distorted; head and neck attached to the side of the trunk; egg strings coiled into spirals_____ 7
5. Cephalothorax and neck straight and attached at right angles to the side of the trunk some distance behind the anterior end.
Peradcrma Heller, 1865, p. 49.
5. Cephalothorax and neck with a sigmoid curve and attached to the anterior end of the trunk_____*Cardiodectes*, new genus, p. 50.
6. Two to ten chitinous horns, or two or three small posterior knobs on the cephalothorax; neck not enlarged behind the swimming legs; one pair of maxillae_____*Lernaeenicus* Le Sueur, 1824, p. 56.
6. Two lateral horns on the cephalothorax, soft and unbranched; neck enlarged behind the swimming legs; two pairs of maxillae.
Sarcotretes Jungersen, 1911, p. 69.
7. Neck attached to a lateral anterior corner of the trunk; abdomen minute and hemispherical_____*Phrixocephalus* Wilson, 1908, p. 74.
7. Neck attached to the center of the dorsal surface of the trunk, abdomen as long as the trunk and turned sidewise_____*Collipravus*, new genus, p. 78.
8. Egg strings looped into loose masses_____ 9
8. Egg strings coiled into regular tight spirals_____ 10
9. No abdominal processes; trunk soft and fleshy; cephalic horns very irregular.
Lernaeocera Blainville, 1822, p. 83.
9. Five or six branched processes along either side of the abdomen; integument of every part of the body thick and chitinized; cephalic horns regularly branched_____*Lernaeolophus* Heller, 1865, p. 89.
10. Head and neck with lateral processes, simple and soft; neck reflexed upon itself; abdomen two-thirds as long as the trunk and regularly tapered.
Haemobaphes Steenstrup and Lütken, 1861, p. 93.
10. Cephalothorax with branched chitin horns; neck very short and not reflexed; abdomen as long as the trunk and expanded at the tip.
Haemobaphoides T. and A. Scott, 1913, p. 100.

10. Cephalothorax with three simple chitin horns, two lateral, one dorsal; neck much longer than the trunk, not reflexed; abdomen half the length of the genital segment, without processes_____*Trifur*, new genus, p. 101.

11. Abdomen with a row of feathery processes along either side; cephalothorax with numerous frontal processes and two or three horns, chitinous and usually simple_____*Pennella* Oken, 1816, p. 105.

11. Abdomen twisted spirally and covered with papilliform villi; neck with small excrescences attached by threads; no horns or frontal processes. *Pegesimallus* Krøyer, 1863, p. 126.

Remarks.—At first the genus *Lernaea* was the only one in the entire group of parasitic copepods, and everything that was parasitic and that seemed likely to be, or even to become, a copepod was placed in this genus by the early investigators. One after another of these species have been removed and made the types of new genera, until all that are left are those included in the present paper. But even after they began to separate new genera investigators still placed them all with *Lernaea* in the family Lernaeidae, which thus became the final dumping ground for everything that was bizarre in form and that could not be located elsewhere. Many of these genera have already been removed and correctly located elsewhere, and it is proposed now to remove all the others that do not show sufficient relationship in morphology and development. Accordingly the five genera, *Sphyrion*, *Strabax*, *Trypaphylum*, *Opimia*, and *Rebellula*, which have heretofore been included in the Lernaeidae, must be dropped for the following reasons: The adult females of these genera have processes at the posterior end of the genital segment in addition to the egg strings, from a single pair (*Opimia*) up to large bunches (*Sphyrion*); the second antennae are neither dorsal nor chelate; there are no swimming legs or anal laminae, and the female carries a pigmy male attached to the posterior end of her body. This last proves at once that the life history is entirely different from that here set forth for the Lernaeidae. These genera will be taken up in a future paper.

The genus *Ive* which was provisionally placed in the Lernaeidae by its founder, Mayer (1879), can not possibly be left there, since it is not a fixed parasite at all and the two sexes are found together moving about freely, with the male 5 mm. in length, or half the size of the female.

The genus *Lernaea* presents so many differences from the other genera that it might seem a question whether it ought to be included with them or established in a family by itself. But from the account of that genus already given (see Bibliography under Wilson) it will be found that the resemblances far overbalance the differences, especially in the matter of the peculiar life history, and the genus is accordingly retained in the present family.

LERNAEINAE, new subfamily.

Subfamily characters of female.—Cephalothorax armed with soft horns or processes, two, three, or four in number and unbranched; trunk straight without a sigmoid curve; genital segment enlarged on the ventral surface, just in front of the vulvae, into a pregenital prominence; egg cases short and sacklike, eggs multiseriate. Two pairs of antennae, second pair uncinate; a pair of curved and spine-like mandibles; two pairs of maxillae; one pair of maxillipeds; swimming legs widely separated with a fifth pair close to the vulvae.

Subfamily characters of male (genus *Lernaea*).—Body like that of *Cyclops*, composed of a cephalothorax covered with a dorsal carapace, three free thorax segments, a genital segment, and a three-jointed abdomen; anal laminae each armed with a single jointed seta, more than half the length of the whole body. Antennae and mouth parts like those of the female; a fifth and often a sixth pair of swimming legs on the genital segment. Parasites of fresh-water fishes exclusively.

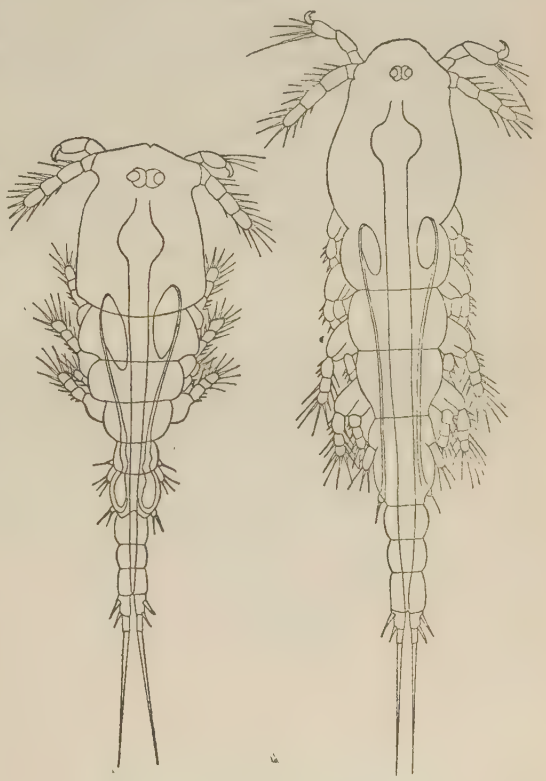

FIG. A.—THE MALE (LEFT) AND FEMALE (RIGHT) COPEPODID LARVAE OF LERNAEA VARIABILIS: ACTUAL LENGTH OF FEMALE, 1.50 MM., INCLUDING THE LONG ANAL SETAE.

Ontogeny of genus Lernaea.—The genital protoplasm at the posterior end of the ovary gradually forms onto long threads or filaments, transversely segmented into cells. These increase in size toward the anterior end of the ovary, and as they pass into the oviduct the filaments break up into their separate cells, each of which forms an egg. The eggs pass down the oviduct to its posterior portion, which serves as a cement gland. Just before entering this portion they are fertilized, and after entering they are covered with an egg membrane composed of the cement substance.

In the external egg sacks development takes place up to the nauplius stage. The larva hatches as a typical nauplius with the usual three pairs of appendages and one pair of balancers. It swims about freely in the plankton during the nauplius and metanauplius stages, undergoing several molts. On reaching the first copepodid stage it seeks as a temporary host some fish other than the one which is to serve as the final host of the female, and both sexes cling to the gill filament by means of their second antennae and maxillipeds, and feed on the fish's blood.

Four copepodid stages are passed here on the gills, the genital segment and abdomen becoming gradually perfected, the reproductive organs being developed, and the swimming legs increasing in number and in the number of segments in the rami. During the fourth copepodid stage both sexes become sexually mature and fertilization occurs. After fertilization the female leaves the gills and swims about freely again in the plankton in search of a final or permanent fish host. She fastens to the skin on the outside of the fish's body by means of her second antennae and maxillipeds, and burrows into the underlying tissues with the aid of these organs and the powerful maxillae. Soft horns or processes then develop from the sides of the cephalothorax, the body is greatly elongated and enlarged, the ovaries migrate back into the genital segment, and the mature adult stage is reached, in which she continues until death.

The male remains upon the gills of the first fish host until death, without further increase in size or other transformation, or he may sometimes leave and swim about freely in the plankton; but he never attains a length of more than a millimeter and a half, does not seek another host, undergoes no changes corresponding to those of the female, and is never found subsequently in the company of the female.

Genus LERNAEA Linnaeus.

Lernaea Linnaeus, Fauna Suecica, 1746, p. 367.
Lernaea Linnaeus, Systema Naturae, 10th ed., 1758, p. 655.
Schisturus (part) Oken, Lehrbuch Naturgeschichte, 1816, p. 182.
Lernecocera (part) Blainville, Journ. de Physique, vol. 95, 1822, p. 375.
Lernaeocera (part) Nordmann, Mikrographische Beiträge, 1832, p. 123.
Lernaeocera Burmeister, Acta Acad. Caes. Leop. Carol. Nat. Cur., vol. 17, 1833, p. 309.
Lernaeocera (part) Milne Edwards, Histoire Naturelle des Crustacés, vol. 3, 1840, p. 526.
Lernaeocera, all subsequent authors.

External generic characters of female.—Head a rounded knob projecting from the anterior margin of the cephalothorax and placed nearly at right angles to the body axis, with a deeply buried, tripartite eye near the center of the dorsal surface; one or two pairs of horns, simple or forked, on the lateral margins of the cephalothorax; sometimes an unpaired horn on the center of the dorsal

margin; all the horns conical and soft; neck soft, slender, and cylindrical, enlarging gradually into the trunk which is also cylindrical; trunk with a pregenital prominence in front of the vulvae; abdomen short and bluntly rounded, terminating in a pair of minute anal laminae; egg strings elongate-conical or ovoid, eggs multiseriate.

Two pairs of antennae, second pair uncinate; proboscis conical and very short; mandibles claw-shaped and without teeth; two pairs of maxillae; one pair of maxillipeds; four pairs of biramose swimming legs, first pair just behind the head, others at increasing distances posteriorly; a fifth pair of one-jointed stumps just in front of the vulvae.

Internal generic characters of female.—Esophagus short, nearly straight, and diagonal to the body axis; anterior stomach with lateral lobes and more or less convoluted; posterior stomach passing insensibly into the intestine, which is straight, of the same diameter throughout, and abruptly contracted into a short rectum; ovaries paired, close to the dorsal surface and near the posterior end of the trunk; matured oviducts with two long posterior and two shorter anterior loops; eggs remaining spherical and never flattened anteroposteriorly; no separate cement glands, the thickened glandular walls of the posterior oviducts serving that purpose.

No separate excretory glands, the chitinogen layer of the skin apparently serving for excretion through the pore canals.

Genus habitat.—This genus fastens to the outside surface of the fish's body, usually in the vicinity of the fins, and bores into the underlying tissues a short distance until it finds an adequate blood supply without seeking any particular organ or blood vessel.

Generic characters of the copepodid male.—The external generic characters have already been given under the subfamily. Internally the esophagus is long and nearly parallel with the body axis; stomach passing insensibly into the intestine and that into the rectum, the entire tube lined with digestive cells filled with black granules; supra ganglion comparatively small, infra ganglion very large and stout and extending back into the genital segment; testes paired, but not always side by side, situated in the head and anterior thorax above the stomach and intestine, spindle-shaped with the sperm ducts leading from their anterior ends back to the large spermatophore receptacles in the genital segment.

Type of the genus.—Lernaea cyprinacea Linnaeus, first species.

(*Lernaea*, Λέρνη, a fabled abode of the hydra.)

Remarks.—In a monograph of this genus by the present author, submitted to the United States Bureau of Fisheries and soon to be published, will be found the complete morphology and life history, together with a full revision of all the known species.

KEY TO THE SPECIES OF LERNAEA.

1. Two cephalothoracic horns, a lateral pair 2
1. Three cephalothoracic horns, a lateral pair and one dorsal and unpaired 3
1. Four cephalothoracic horns, a dorsal pair and a ventral pair 5
2. Horns directed laterally at right angles to body axis; trunk not much wider than neck; pregenital prominence inconspicuous (8.40 mm.)[1]
diceracephala (Cunnington), 1914.
2. Horns diagonal to body axis, directed posterodorsally; trunk suddenly enlarged to four times the diameter of neck; pregenital prominence very large (8 mm.) ..... new species[2].
3. Lateral and dorsal horns all dichotomously branched 4
3. Lateral horns simple, dorsal one bifid at apex; pregenital prominence inconspicuous; abdomen short (10 mm.) ..... new species[2].
3. Lateral horns three or four pronged, dorsal horn bifid at apex; pregenital prominence conspicuous; body clubshaped; abdomen long and wide (7.50 mm.) ..... *pectoralis* (Kellicott), 1882.
4. Lateral horns once bifid, dorsal horn twice bifid; body spindle-shaped; no pregenital prominence (8 mm.) ..... *lagenula* (Heller), 1865.
4. All three horns twice bifid; body clubshaped; pregenital prominence divided, its two lobes and the abdomen the same size (10 mm.)
catostomi (Krøyer), 1863.
4. Lateral horns twice bifid, dorsal horn simple or once bifid; trunk clubshaped; pregenital prominence simple and much smaller than the abdomen (12 mm.) ..... *tortua* (Kellicott), 1882.
5. Dorsal and ventral horns about the same size 6
5. Ventral horns much smaller than the dorsal 9
6. Pregenital prominence simple and shorter than the abdomen 7
6. Pregenital prominence divided, its lobes as long as the abdomen 8
7. Abdomen short and plump; pregenital prominence forming a distinct "heel"; ventral horns bifid (5.70 mm.) ..... *phoxinacea* (Krøyer), 1863.
7. Abdomen short and plump; pregenital prominence not forming a distinct "heel"; dorsal horns bifid (13.50 mm.) ..... *esocina* (Burmeister), 1835.
7. Abdomen long and stout; pregenital prominence forming a distinct "heel"; all the horns simple (14.30 mm.) ..... *haplocephala* (Cunnington), 1914.
8. Pregenital prominence divided into three broadly rounded lobes; horns long, slender, straight (13.50 mm.) ..... *pomotidis* (Krøyer), 1863.
8. Pregenital prominence twice bifid, forming four narrow lobes; horns short, plump, curved (10 mm.) ..... *cruciata* (Le Sueur), 1824.
9. Pregenital prominence divided into distinct lobes; dorsal horns simple and undivided 10
9. Pregenital prominence simple or only slightly indented; dorsal horns distinctly forked 11
10. Abdomen a short and broad triangle; dorsal horns cylindrical and standing out laterally at right angles to the body axis (9 mm.)
tenuis (Wilson), 1916.
10. Abdomen long and plumply conical; dorsal horns flattened dorso-ventrally and curved forward in front of the head and parallel to the body axis (11.50 mm.) ..... *variabilis* (Wilson), 1916.
11. Abdomen short and inclined to body axis; egg cases broadly elliptical; ventral horns mere knobs (14 mm.) ..... *barnimii* (Hartmann), 1870.

[1] Average total length of species.
[2] Named and described in the monograph mentioned under remarks, p. 37.

11. Abdomen short and inclined to body axis; egg cases narrow and elongate-cylindrical; ventral horns half the length of the dorsal (22.50 mm.) *cyprinacea* (Linnaeus), 1758.

11. Abdomen long and parallel with body axis; ventral horns very short and slender spikes (10 mm.)_____*temnocephala* (Cunnington), 1914.

As would naturally be inferred a great many species that were originally ascribed to this genus have subsequently been transferred to other genera. These may be most easily recorded in the form of a table giving first the original species of the genus, then the author, and finally the present genus and species. It will be noted that some of the transferences are not merely from one genus to another, but also into a new family, which may be not even very closely related to the Lernaeidae.

Species.	Author.	Present genus.	Present species.
adunca	Ström, 1762	*Clavella*	*uncinata.*
anomala	Abildgaard, 1794	*Clavella*	*anomala.*
asellina	Linnaeus, 1761	*Medesicaste*	*asellinum.*
cirrhosa	La Martinière, 1787	*Pennella*	*filosa.*
clavata	Müller, 1776	*Peniculus*	*clavatus.*
cornuta	Müller, 1776	*Chondracanthus*	*cornutus.*
cyclophora	Blainville, 1822	*Lernaeenicus*	*sprattae.*
cyclopterina	Müller, 1776	*Haemobaphes*	*cyclopterina.*
dalmanni	Retzius, 1831	*Charopinus*	*dalmanni.*
diodontis	Oken, 1816	*Pennella*	*diodontis.*
elongata	Grant, 1827	*Lernaeopoda*	*elongata.*
encrasicholi	Turton, 1807	*Lernaeenicus*	*encrasicholi.*
exocoeti	Holten, 1802	*Pennella*	*exocoeti.*
gadina	Müller, 1776	*Lernaeocera*	*branchialis.*
gobina	Müller, 1776	*Diocus*	*gobinus.*
hemirhamphi	Kroyer, 1863	*Lernaeolophus*	*hemirhamphi.*
huchonis	Schrank, 1786	*Basanistes*	*huchonis.*
lavareti	Fabricius, 1794	*Ergasilus*	*sieboldii.*
marionis	Blainville, 1822	*Pennella*	*sagitta.*
merluccii	Holten, 1802	*Chondracanthus*	*merluccii.*
nodosa	Müller, 1776	*Chondracanthus*	*nodosus.*
ocularis	Cuvier, 1830	*Lernaeenicus*	*sprattae*
pectoralis	Müller, 1776	*Lepeophtheirus*	*pectoralis.*
pinnarum	Fabricius, 1779	*Clavella*	*uncinata.*
radiata	Müller, 1776	*Chondracanthus*	*radiatus.*
salmonea	Linnaeus, 1761	*Salmincola*	*salmonea.*
spratta	Sowerby, 1806	*Lernaeenicus*	*sprattae.*
tentaculis quatuor	Linnaeus, 1746	*Lernaea*	*cyprinacea.*
uncinata	Müller, 1776	*Clavella*	*uncinata.*

In addition to the above species, which can be located with reasonable certainty, there are also others which have never been described with sufficient accuracy to enable one to locate them with any certainty, nor even with any probability.

LERNAEA BASTERI Blainville, 1822, p. 437.

"The body is white and divided into two parts by a constriction; the abdomen is very large and oval; the cephalic enlargement is globular; the mouth is inferior and provided with a double pair of

hooks, by means of which the animal fastens itself. I know this species only through Baster, who observed that this animal bore considerable resemblance to that figured by Gissler. (Acta Holmiae, 1751, p. 90; pl. 6, figs. 1–5.)"

This is the only description ever given, and while it shows that the creature can not belong to the genus *Lernaea*, it does not tell us where it can be placed.

LERNAEA GADUS-MINUTUS Hesse, 1891, p. 191.

In the text Hesse spoke of this "Lernée du Gade petit" as though it were a new species, but in the explanation of the plate (pl. 7, figs. 1–9) he distinctly called it the larva of "Lernaea branchialis du Gade petit," which seems to be what it really was.

LERNAEA LOTAE Hermann, 1783.

Oken in 1816 separated the genus *Schisturus*, in which the body was soft, from the genus *Lernaea*, in which it was covered with a horny skin. He placed the species *lotae* in this new genus and gave for it the following description: "Vier ungleiche Eierschnüre, am Mund zwei Häkschen."

This was probably some genus that possessed paired posterior processes, since none of the copepod parasites have four egg strings. At all events it was not a Lernaean.

LERNAEA MULTICORNIS Cuvier, 1830, p. 256.

"Il y en a une a cornes petites, inegales et tres nombreuses (*L. multicornis*, Cuv.) sur les ouies d'un serran des Indes." This has never been seen or mentioned by any other author, and its attachment to the eye renders it highly improbable that it belongs to the genus *Lernaea*.

Genus LEPTOTRACHELUS Brian.

Silvestria Brian, Atti del Soc. Ligustica di Scienze, vol. 13, 1903, 6 pp. 1 text fig.

Leptotrachelus Brian, Zool. Anz., vol. 26, 1903, p. 547.

External generic characters of female.—Cephalothorax with two or three soft, cushionlike protuberances or horns, varying in size and shape; head considerably swollen; neck long, straight, and slender, or sometimes bent into a U-shape, covered anteriorly with a cutaneous sheath, monilliform posteriorly; trunk abruptly enlarged, subcylindrical, thickest anteriorly, tapering posteriorly, with numerous transverse wrinkles but without a pregenital prominence, straight or slightly curved; no abdomen; egg strings, antennae, mouth parts, and swimming legs unknown: male also unknown.

Type of the genus.—*Leptotrachelus truchae* Brian, monotypic. (*Leptotrachelus*, λεπτός, slender and τράχηλος, neck.)

Remarks.—Brian established this odd genus upon several specimens sent to him by the Italian investigator, Filippo Silvestri, and obtained from "*Percichtys trucha*," taken in the Santa Cruz River, Patagonia. He first named the genus *Silvestria*, but this name being preoccupied he changed it to *Leptotrachelus*. It apparently bears more resemblance to the Lernaeinae than to the other subfamilies, and, as it came from fresh water, we may leave it here until further data are obtained.

Genus THERODAMAS Krøyer.

Therodamas Krøyer, Bidrag til Kundskab om Snyltekrebsene, 1863, p. 316, pl. 15, fig. 4, *a—f*.

External generic characters of female.—Body divided into two parts, the anterior one resembling a slender neck ending in a swollen spherical head, the posterior one considerably wider, distinctly segmented, and tapering backwards. Anterior portion really a median dorsal process, but carrying on its swollen tip a pair of stout uncinate second antennae. First segment of the posterior portion the true head, bearing the proboscis and mouth-parts on its ventral surface. First, second, third, and fourth thorax segments the same width as the head and each bearing a pair of swimming legs. Genital segment strongly tapered posteriorly; abdomen short and deeply parted in the center; anal laminae small and armed with stout setae; egg strings spindle-shaped; eggs small, multiseriate, and not definitely arranged. First antennae unknown; second pair stout and uncinate; proboscis short and blunt; one pair of mandibles, two pairs of maxillae, no maxillipeds; swimming legs well separated, all four pairs biramose, rami 3-jointed and armed with plumose setae.

Type of the genus.—*Therodamas serrani* Krøyer, monotypic.

(*Therodamas*, Θεροδάμας, a Scythian king who fed lions with human flesh.)

Remarks.—Krøyer obtained a goodly number of adult females from the gills of a species of *Serranus* in the Danish West Indies. The present author searched long and carefully for this odd genus upon various genera and species of the groupers at Jamaica in 1910, but without success.

The chief peculiarity of the genus is the curious median and dorsal prolongation of the head, which looks exactly like a slender neck, and to complete the resemblance its anterior end is enlarged like a head and carries on its dorsal anterior margin a pair of uncinate second antennae like those of the other Lernaean genera. The first antennae are apparently lacking, but possibly Krøyer overlooked

them. The mouth being on the ventral surface of the first segment of the part posterior to this apparent neck shows that it is not a neck at all and that the swollen anterior end of it is not a head. But in spite of such an anomalous arrangement this genus admirably supplements the others in the family. In most of the genera (*Lernaeocera*, *Pennella*) the excessive elongation of the body of the adult female takes place in the fifth and genital segments, the first four thorax segments having no share in it. In *Peniculus* the third and fourth segments are elongated a little but not nearly as much as the fifth and sixth segments. In *Lernaea* all the thorax segments share in the elongation, the posterior ones more than the anterior. And here in *Therodamas* also all the thorax segments share in the elongation, but the anterior ones are elongated more than the posterior, and the head, which in other genera has only sent out lateral and dorsal processes, is here elongated anteriorly. The wide separation of the swimming legs and the multiseriate, sack-like egg strings place the genus in the subfamily of the Lernaeinae.

LERNAEENICINAE, new subfamily.

Subfamily characters of female.—Cephalothorax armed with hard chitin horns, more or less profusely branched, or with soft cushion-like lateral processes, or with branched frontal processes, sometimes two of these combined; neck cylindrical and usually very slender and chitinous; trunk straight, without a sigmoid curve; genital segment enlarged but destitute of a pregenital prominence; egg strings long and thread-like; neither in coils nor spirals, eggs uniseriate. Two pairs of antennae, the second pair chelate; mandibles in the form of straight spines; one or two pairs of maxillae; no maxillipeds; first two pairs of swimming legs close together just behind the head, one or two other pairs at short intervals.

Subfamily characters of male (*genus Sarcotretes*).—Body like that of *Cyclops*, composed of a cephalothorax covered with a carapace and furnished anteriorly with a stout attachment filament; three free thorax segments, and a fused, one-jointed, genital segment and abdomen; anal laminae rather small, each armed with four or five tiny setae of varying length. Antennae and mouth parts like those of the female with the addition of the rudiments of a pair of maxillipeds; two pairs of biramose swimming legs with two-jointed rami, a third pair uniramose, rami also two-jointed.

Parasites of salt-water fish exclusively.

Ontogeny of genus Sarcotretes.—The genital protoplasm in the posterior end of the ovary gradually forms into egg mother-cells and these into egg daughter-cells, which are uniformly distributed throughout the anterior half of the ovary without forming filaments.

Each egg daughter-cell as it passes into the oviduct accumulates yolk and food material and becomes a mature egg. In the oviduct these eggs are strongly flattened antero-posteriorly and packed together like a row of coins. The cement glands are entirely separate from the oviducts and open into the latter close to the vulvae, covering each egg with an external membrane just before it passes out into the egg strings. Here the eggs are again packed like a row of coins, but are now separated by the membranes. The nauplius and metanauplius stages have not been seen, but in all probability are passed as free-swimming larvae in the plankton.

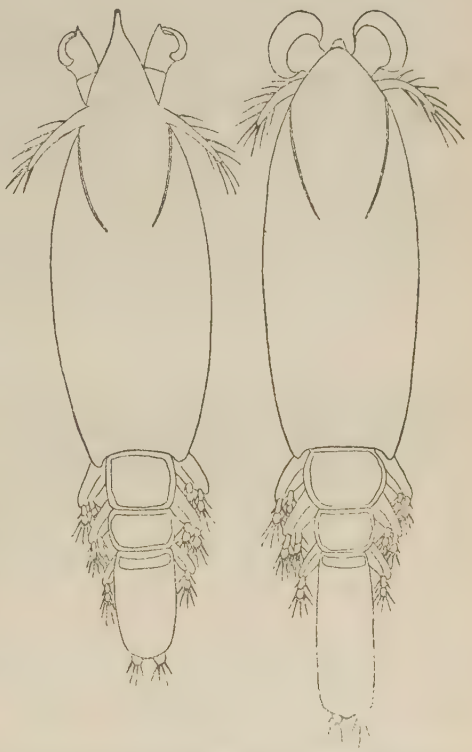

FIG. B.—THE MALE (LEFT) AND FEMALE (RIGHT) COPEPODID LARVAE OF SARCOTRETES SCOPELI. AFTER JUNGERSEN: ACTUAL LENGTH OF FEMALE, 2MM.

In the genus *Sarcotretes* the first copepodid larvae sought as a temporary host the same fish to which the fertilized female afterwards fastened as a permanent host. But these copepodid larvae fasten not to the gills but to the fins of the fish by means of their strong chelate second antennae. At the close of this stage the larva fastens itself to the fish by firmly cementing to the fish's skin the terminal disk of a stout frontal filament developed in the anterior part of the cephalothorax, and remains thus attached during the subsequent copepodid stages. These stages are called pupal, because during them the antennae, mouth parts, and swimming legs all lose their distinct segmentation and often their setae and become swollen and clumsy. The reproductive organs, however, are developed so that at the close of the last pupal stage, when the appendages are restored to their former condition, the young males and females shed their frontal filaments and swim about again freely in the plankton where fertilization occurs. After fertilization the males die and the females seek again the same species of fish for their final host, fastening to its skin by the chelate second antennae. They then bur-

row into the tissues of the host by means of the antennae and the mouth parts and finally reach the intestines, where they are permanently anchored by the outgrowth of processes or horns from the sides of the cephalothorax.

Genus PENICULUS Nordmann.

Peniculus NORDMANN, Mikrographische Beiträge, 1832, p. 107, pl. 6, figs. 8 to 14.

External generic characters of female.—Cephalothorax distinctly separated from the rest of the body, elliptical, flattened dorso-ventrally, covered with a carapace which often shows lateral lobes, and destitute of horns or processes; neck composed of second and third thorax segments, much narrowed, flattened dorso-ventrally, and chitinized; fourth segment more or less spherical and much widened; trunk composed of the fifth and genital segments fused and a minute abdomen; egg strings slender and much longer than the trunk; eggs uniseriate. Second antennae strongly chelate; eye tripartite and deeply buried; probosis long, conical, and retractile; two pairs of maxillae; second pair uncinate.

Internal generic characters of female.—Esophagus strongly inclined to the body axis; stomach only slightly enlarged and without convolutions; intestine straight, much wider than the stomach, dorsal and abruptly contracted into a very short rectum (fig. 14); well-defined supra and infra esophageal ganglia with distinguishable nerves; ovaries dorsal to the intestine and near the anterior end of the trunk; oviducts passing from the anterior ends of the ovaries around the intestine to the ventral surface and straight back to the vulvae; oviducts long and comparatively narrow; cement glands close together and ventral to the oviducts, the glandular portion as wide as, or wider than, the oviducts and usually distinctly segmented, the ducts sometimes parallel, sometimes convergent posteriorly and opening into the oviducts near the vulvae; paired digestive glands on either side of the esophagus and anterior stomach; paired excretory glands on the ventral surface of the fourth thorax segment.

Genus habitat.—This genus does not burrow into the tissues of its host, but is always found upon the fins, usually the dorsal fins. It fastens itself to the bone of one of the fin rays by means of its second antennae, and the chelae of these antennae are usually so covered with osseus tissues whose growth is induced by the irritation, that it is impossible to separate them from the ray.

Type of the genus.—*Peniculus fistula* Nordmann, monotypic.

(*Peniculus*, the name of a parasite in Plautus.)

Remarks.—This genus was established and meagerly described by Nordmann but was not definitely located. Milne Edwards placed it

in the Chondracanthidae, while Claus (1858) was the first to recognize it as a Lernaean. Krøyer (1863) added two new species, *clavatus* and *furcatus*, having only a single specimen of the latter, and Nordmann in 1864 added the new species *calamus*, which was not figured and has never been seen by any investigator since, but whose description and size are sufficient to warrant its validity.

Claus in 1868 described in much greater detail Nordmann's type species and the present author did the same for Krøyer's species *furcatus* in 1906, still retaining it in the genus and among the Lernaeidae. But after the present detailed study of this family and especially of their internal anatomy the species *furcatus* can no longer be kept in the genus, and there are many good reasons for transferring it to another family. Chief among these reasons are the following:

1. While the second and third thorax segments are narrower than the carapace there is no formation of a definite chitinized neck.

2. The fourth thorax segment is indistinguishably fused with the fifth and genital segments, the only indication of its presence being a pair of fourth legs on the ventral surface of the trunk.

3. The trunk is much too short and too strongly flattened dorso-ventrally for a Lernaean; it has large posterior processes, as long as itself, into which the body cavity extends; it has a distinct abdomen, also strongly flattened dorso-ventrally, and also with posterior processes into which the body cavity extends.

4. The second antennae are distinctly ventral and are not chelate, there is no retractile proboscis, and all four pairs of legs are biramose with one-jointed rami.

5. The ovaries extend forward nearly to the anterior end of the fourth thorax segment; the eggs in the oviducts are more or less spherical and not packed like a row of coins; the egg strings are very short and stout and there are only 10 or 15 eggs in each string.

Such cumulative differences necessitate the separation of this species from the others in the present genus and the new name *Peniculisa furcata* is proposed for it. Furthermore, the majority of these differences are just as effective for separating it from the Lernaeidae, and as they all correspond with the characters of the Dichelestiidae the present author would transfer the species to that family.

This leaves in the genus *Peniculus* three species already described, to which is here added a fourth that is new to science.

KEY TO THE SPECIES.

1. Trunk short, twice as long as wide; proboscis also short and slender; second antennae enlarged into disks at the tips (5 mm.)[1] *calamus* Nordmann, 1864.

[1] Average total length of species.

1. Trunk three and a half times as long as wide; proboscis long and stout; fourth segment two-thirds as wide as the trunk (9 mm.)
clavatus Krøyer, 1863, p. 46.

1. Trunk five times as long as wide; proboscis short and slender; fourth segment less than half the width of the trunk (9mm.) *fistula* Nordmann, 1824.

1. Trunk seven times as long as wide; proboscis short and stout; fourth segment only slightly narrower than the trunk (6.25 mm.)
fissipes, new species, p. 47.

PENICULUS CLAVATUS (Müller).

Plate 1, figs. 1–7.

Peniculus clavatus Krøyer, Bidrag til Kundskab om Snyltekrebsene, 1863, p. 266, pl. 14, fig. 8, *a–g*.
Lernaea clavata Müller, Zoologia Danica, 1779, p. 38, pl. 33, fig. 1.

Host and record of specimens.—Eleven specimens were obtained from the fins of *Sebastes marinus* by the United States Bureau of Fisheries steamer *Speedwell* during the summer of 1878 at stations 138, 184, and 198 off Cape Ann, Massachusetts. These 3 lots have received respectively Cat. Nos. 47782, 38028, and 47781, U.S.N.M.

A single female was taken from the dorsal fin of the same host off Salem, Massachusetts, in August, 1877, and has been given Cat. No. 47783, U.S.N.M.

Specific characters of female.—Cephalothorax subspherical, as wide as long, a little pointed anteriorly where it forms a bluntly rounded rostrum, to whose lateral margins are attached the first antennae, and to whose anterior margin are attached the larger chelate second antennae; no horns or processes of any description; ventral surface circular in outline and deeply concave, the long proboscis being attached to the bottom of the depression.

The second and third thorax segments form a slender neck, flattened dorso-ventrally, chitinized, somewhat enlarged through the bases of the third legs, and bent forward at an angle of 45° just in front of the enlargement.

Fourth segment two-thirds the width of the trunk, from which it is separated by a deep groove; the fourth legs are attached to its posterior margin. The trunk is cylindrical, three and a half times as long as wide, of the same diameter throughout, and abruptly rounded posteriorly. The abdomen is a minute tubercle close to the dorsal surface, but showing distinct anal laminae, each of which is armed with three long setae and two shorter ones. The egg strings are one-fourth the width of the trunk and nearly twice the length of the entire body.

The first antennae are turned backward along the lateral margins of the cephalothorax; they are three-jointed, the basal joint the shortest, the second joint the longest, the two terminal joints well armed with setae. The second antennae are stout and unguiculate,

with their basal joints large, considerably inflated, and fused only at their origin, while the terminal claws are stout, strongly curved, and folded downward and inward against the basal joints and toward each other.

The proboscis is as long as the neck and of medium diameter, somewhat narrowed at the tip with an intricate supply of muscles for retraction and protrusion. The mouth opening is terminal and circular and is surrounded by a delicate fringed membrane. The first maxillae are minute and one-jointed, tipped with a small seta and situated on the sides of the proboscis just at the base of the terminal narrowing. The second pair are also on the sides of the proboscis, posterior and ventral to the first pair; they are slender and two-jointed, the terminal joint half the length of the basal and tipped with a short curved claw. Only the basal plates are present in the four pairs of legs, the rami having disappeared; these plates are notched on the outer margin near the distal end.

Total length, 9 mm. Trunk, 7.50 mm. long, 2 mm. wide. Egg strings, 17 mm. long, 0.50 mm. wide.

Color (preserved material). Head and neck a grayish yellow, trunk a dark cinnamon brown, egg strips a lighter brown.

(*clavatus*, club-shaped.)

Remarks.—This species was originally described by Müller and referred to the genus *Lernaea*, but when Krøyer rediscovered it he recognized at once that it did not belong to that genus but to Nordmann's *Peniculus*.

Claus suggested (1868, p. 12) that Krøyer's *clavatus* and Nordmann's *fistula* were the same species, but the present description and figures make it certain that the two species are distinct. The general body proportions are very different, as can be seen from the key (p. 46), especially the length of the proboscis and trunk, the width of the fourth segment, and the relative size of the abdomen. These differences are carried still farther in the details of the appendages, none of which correspond with those given by Claus for *fistula*.

Claus recorded that the first antennae were broken on all the specimens at his disposal, but fortunately they were present on several of the present specimens and are given in detail in figure 3.

As distinctive characters in the internal anatomy of this species we may notice the comparatively narrow oviducts and wide cement glands, the glandular portion of the latter being actually wider than the oviducts and distinctly segmented. The ovaries also are short and broadly ovate or heart-shaped.

PENICULUS FISSIPES, new species.

Plate 2, figs. 8–14.

Host and specimens.—Seven females were obtained from the fins of an unknown fish by the United States Bureau of Fisheries

steamer *Albatross* at Laredo Bay, in the Straits of Magellan, January 22, 1888. These have received Cat. No. 47784, U.S.N.M, and become paratypes of the new species; from them a single female was selected to serve as the species type with Cat. No. 47785, U.S.N.M.

Specific characters of female.—Cephalothorax elliptical, a little less than twice as long as wide and flattened dorso-ventrally, with a well-defined lateral lobe on either side at the posterior end; rostrum short and wide and broadly rounded; tripartite eye large and so deeply buried as to be nearer the ventral than the dorsal surface. Neck comparatively wide and bent ventrally at an angle of 45°; third thorax segment elongated, but not much widened posteriorly; fourth segment relatively long and nearly as wide as the trunk, from which it is separated by a deep groove.

Trunk narrow-cylindrical and seven times as long as wide, squarely truncated posteriorly; abdomen hemispherical and half the diameter of the trunk, with well-defined anal laminae, each armed with three long plumose setae and two smaller, non-plumose ones; egg strings one-third the diameter of the trunk and two-thirds longer than the entire body, with narrow masses of cement substance at their tips.

First antennae slender and three-jointed, basal joint the shortest, the other two about equal and well armed with setae; second antennae with a stout basal joint and a short and strongly curved terminal claw; proboscis short and wide, mouth opening large, circular, and terminal, surrounded by a narrow stiff rim; first maxillae minute, one-jointed, tipped with two tiny setae and fastened to the lateral wall of the proboscis; second maxillae comparatively large, basal joint long and stout and armed with a short spine on the posterior margin near the center, second joint half as long and tipped with a short curved claw; the distal end of the basal joint and the proximal end of the second joint are tapered so that the appendage is narrowed at the joint. The basal laminae of the first three pairs of swimming legs are rounded triangular, with a narrow sinus on the inner margin near the base, each one split diagonally from the apex of the triangle to the base of this sinus. The fourth pair has a knob in place of the sinus and the split extends only to the center of the lamina.

Total length, 6.25 mm. Length of trunk, 5.12 mm.; width, 0.75 mm. Length of egg strings, 10.50 mm.; width, 0.25 mm.

Color (preserved material), a uniform light yellow, the carapace and swimming legs with spots of dark brown pigment more or less symmetrically arranged.

(*fissipes*, *fissus*, cleft and *pes*, foot, alluding to the diagonal split in the basal laminae of the swimming legs.)

Type.—Female, Cat. No. 47785, U.S.N.M.

Remarks.—It is unfortunate that the name of the host of this interesting species was not known or at least was not recorded. Its chief external distinguishing characters are the long and narrow trunk, the long and wide fourth thorax segment, and the split basal plates of the legs. In the internal anatomy especial attention is called to the exceptionally long ovaries, which are conical, extend nearly the entire length of the trunk, and taper to a sharp point posteriorly. The oviducts are a little wider than the ovaries and also a little longer, since they extend to the vulvae. The glandular portion of the cement glands is relatively short and very indistinctly segmented, the ducts are longer than the glandular portion and straight. The intestine is comparatively narrow.

Genus PERODERMA Heller.

Peroderma HELLER, Reise der Fregatte *Novara*, 1865, p. 250.
Taphrobia CORNALIA, Atti della Societa Italiana di Scienze Naturali, vol. 18, 1875, pt. 2, pp. 197–200.

External generic characters of female.—Cephalothorax globular, without horns but with a dense tuft of ramifying tubules on the frontal margin of the head; the bases of these tubules are swollen into flasks and their tips are somewhat tumid; neck cylindrical, joining the trunk at right angles about one-third the distance from its anterior end; trunk an elongated ovoid, narrowing posteriorly; egg strings attached to the posterior end and four times the length of the trunk, slender and straight; eggs numerous, uniseriate, and tightly packed like a row of coins; no abdomen.

First antennae three-jointed, setiferous; second antennae two-jointed, chelate; proboscis short and conical, inclosing a pair of mandibles; two pairs of maxillae, the second pair tipped with stout claws; three pairs of swimming legs, first two pairs close together and biramose, third pair removed some distance and uniramose, all the rami two-jointed and bearing plumose setae (adapted from Richiardi, 1876).

Internal generic characters of female.—No exact description can be given through lack of material, but from the analogy of the new genus *Collipravus* (p. 78) it is certain that the insertion of the neck into the side of the trunk instead of at the anterior end profoundly modifies the arrangement of the generative organs and the digestive tube. And hence the internal morphology, when obtained, will differ markedly from that of *Lernaeenicus*, *Sarcotretes*, and *Cardiodectes*. But since the neck is inserted in the center (laterally) of the trunk and at right angles to its axis it does not seem probable that there will be any disturbance of the bilateral symmetry, as there is in *Collipravus* and *Phrixocephalus*.

Genus habitat.—This genus burrows into the lateral muscles of its host and penetrates to the vertebral column; the tubular cephalic processes adhere to the vertebrae, pass through the apertures in the lateral hypophyses, and finally reach the peritoneum.

Type of the genus.—*Peroderma cylindricum* Heller, monotypic. (*Peroderma*, πείρω, to pierce, and δέρμα, the skin.)

Remarks.—The distinctions which separate this genus from *Lernaecenicus* and *Cardiodectes* are given elsewhere (p. 51). Richiardi, from whose description and figures the above genus diagnosis is taken, afterward (1881) briefly described a second species, *petersi*, and a year later a third species, *bellottii*, for neither of which were any figures given. This third species, again described and figured by Jungersen in 1911, is here referred to the new genus *Cardiodectes* (p. 52).

With reference to the species *petersi* Richiardi said that it differed from *cylindricum* in the greater development of the cephalothorax, in the larger number of tubular cylindrical appendages, disposed regularly in tufts, in the fact that the neck was straplike instead of cylindrical, in the subterminal insertion of the neck in the trunk, in the curvature of the trunk, and in the fact that the egg strings were four in number instead of two, were coiled into a tight spiral, and were separated a little distance from one another. Whatever may have been the form which he thus described, it is reasonably certain that it did not belong to the genus *Peroderma*.

The species *branchiata* proposed by Bassett-Smith[1] was not described in sufficient detail to warrant its separation from *cylindricum*, and it can not be established as a valid species until such distinguishing characters are forthcoming.

Thus we are left with only the original type species.

CARDIODECTES, new genus.

External generic characters of female.—Cephalothorax ellipsoidal, with a tripartite eye at the anterior end over the base of the esophagus and not very deeply buried; entire anterior portion covered with dichotomously branched processes, subcorneous in texture, which radiate chiefly from a pair of anterior horns and which form a spherical mass nearly equal in diameter to the trunk; horns continued along the lateral margins; neck hardened but remaining one-third the diameter of the trunk, bent twice at right angles, first backward at the base of the cephalothorax, then forward at about the center; trunk cylindrical and straight; abdomen hemispherical and dorsal, with a pair of minute anal laminae; egg strings long and straight, eggs tightly packed. Two pairs of minute antennae, second pair chelate; one pair of tiny maxillae; four pairs of swimming legs, first two pairs

[1] Ann. Mag. Nat. Hist. (7), vol. 1, 1898, p. 13.

close together and biramose, third pair removed a little distance and uniramose, fourth pair still farther back and destitute of rami; all the rami present are two-jointed and heavily armed with setae.

Internal generic characters of female.—Esophagus at right angles to the axis of the cephalothorax; stomach without convolutions; intestine passing to the dorsal surface of the trunk; rectum short and inclined toward the dorsal surface; ovaries situated near the anterior end of the trunk, dorsal to the intestine; oviducts straight and flattened laterally; cement glands straight, narrow, and parallel, glandular portion shorter than the ducts; chitinogen layer of body wall especially well developed in the anterior thorax and neck, where the outer layer shows numerous pore canals.

Genus habitat.—This genus penetrates from the outer surface of the isthmus of the host through the intervening tissues and buries its head with the anterior processes in the bulbus arteriosus of the fish's heart.

Type of the genus.—*Cardiodectes medusaeus* (Wilson), first species.

(*Cardiodectes*, καρδία, the heart, and δηκτής, a biter or torturer.)

Remarks.—This new genus is established to include the species originally described by the present author as *Lernaeenicus medusaeus* in 1909, and noted by Brian in 1912, and a species described by Richiardi in 1882 as *Peroderma bellotti* and noted by Jungersen in 1911.

For the original description of *medusaeus* there was but a single specimen available, and it could not be injured. Hence, investigation was confined to what could be seen from the outside without removing the branched processes. In the present instance these processes were removed and the cephalothorax was cleaned of everything except the lateral horns. In this way the antennae and mouth parts were laid bare.

This genus differs from *Lernaeenicus* in that it has these processes in place of hard chitin horns, it shows no body torsion, the proboscis is not extensile, and there are but three pairs of legs with rami instead of four.

The two species mentioned above do not belong to the genus *Peroderma*, as suggested by Jungersen, first because that genus does not possess the soft and laminate lateral horns, which here appear behind the processes. Again, in *Peroderma* the processes are tubular, and their interior communicates with the general body cavity; they also cover the entire head and conceal the antennae and mouth parts. Here they are solid and the swimming legs and antennae are left free.

In *Peroderma* the neck is at right angles to the trunk and opens out of the side of the latter, as in the new genus *Collipravus*, but

here the neck is a continuation of the trunk in line with the body axis, as in *Lernaeenicus*.

This must produce a great difference in the internal anatomy and alone is sufficient to distinguish the genera. The swimming legs are smaller and less developed in the present genus, and only the cephalothorax is buried in the bulbus arteriosus of the fish's heart, while in *Peroderma* the entire body is buried in the lateral muscles of the host, leaving only the egg strings hanging free, and the tubular cephalic processes adhere to the vertebral column. The species may be distinguished as follows:

KEY TO THE SPECIES.

Egg strings much longer than the body; soft lateral horns entirely confined to cephalothorax ..... *medusaeus* (Wilson), 1908, p. 52.
Eggs strings only a quarter the length of the body; lamellar wings on the thorax also ..... *bellottii* (Richiardi), 1882, p. 55.

CARDIODECTES MEDUSAEUS (Wilson).

Plate 3, figs. 15–23.

Lernaeenicus medusaeus Wilson, 1908, p. 458, pl. 76, figs. 99 and 100.—Brian, 1912, p. 27, pl. 10, figs. 1–5.

Host and record of specimens.—Two females were obtained from the throat of *Nannobrachium leucopsarum* on the Pacific coast at stations 4434 and 4541 by the United States Bureau of Fisheries steamer *Albatross* in 1904.

One has received Cat. No. 47786, U.S.N.M., while the other was sacrificed to obtain the data given below. Both specimens, as also the one obtained in 1908, were fastened to the throat of their host, with the head and frontal processes buried in the bulbus arteriosus of the heart, the body turned back at right angles outside the fish's skin, with the ventral side of the parasite toward its host. Naturally there would be but a single specimen on each fish, since there would be no room for a second parasite's head within the fish's heart. A third specimen was obtained by the Bureau of Fisheries' steamer *Albatross* at Misaki, Japan, in the throat of *Diaphus glanduliferus*. As the host is small the two have been preserved together with Cat. No. 47823, U.S.N.M.

Specific characters of female.—Cephalothorax ellipsoidal, nearly as wide as long and evenly rounded; a pair of soft horns extending forward from the anterior margin and a second pair extending outward and ventrally from the postero-lateral margin, the bases of the two pairs running together along the sides of the head. The posterior pair are divided into lobes, more or less swollen into spheres, while the anterior pair are strongly flattened dorso-ventrally, and from them chiefly, but also to some extent from the ante-

rior surface of the head, radiate the dichotomously branched soft processes, whose tips are tumid and swollen into spheres.

These processes radiate backward along the surface of the head as well as forward and sidewise, and entirely cover the anterior cephalothorax, extending back dorsally to the second antennae and ventrally to the base of the posterior horns. They thus form an ovoid mass (fig. 16), the point of the oval anterior and the long axis inclined to the axis of the head.

Anterior thorax enlarged and bent dorsally at right angles to the head, then narrowed posterior to the fourth pair of legs into a cylindrical and chitinized neck, which is again bent at right angles, this time ventrally, bringing the axis of the trunk parallel to that of the head.

Trunk cylindrical, increasing gradually to its full diameter and then continuing that size throughout its entire length, with a slight lobe on either side around the vulva. Abdomen hemispherical, inclined dorsally, and about one-third the diameter of the genital segment and one-half longer than wide. Egg strings one-fourth the diameter of the trunk and one-half longer than the entire body.

First antennae two-jointed, the terminal joints well armed with setae and turned outward and downward parallel with the dorsal surface of the head and at right angles to the head axis. Between the bases of these antennae and projecting from the dorsal surface is a small rostrum. Second antennae three-jointed, thickset, and chelate. Proboscis turned down ventrally between the bases of the anterior horns and consisting of a short tube somewhat enlarged at the tip and nonretractile, judging by the lack of muscles. Dorsal to the base of the proboscis and anterior to the end of the stomach is a well-defined tripartite eye, which is not very deeply buried. On either side of the proboscis near the tip is a minute two-jointed maxilla, the terminal joint tipped with a short claw.

Of the four pairs of swimming legs the first two are close together and just behind the bases of the posterior horns of the head, the third pair is removed a greater distance and is attached in front of the groove between the third and fourth segments, while the fourth pair is at a still greater distance and just in front of the beginning of the neck. Each leg consists of a triangular basal joint joined to its fellow by a chitin framework across the midline; each leg of the first two pairs has two short rami, the third leg has but one, while the fourth leg has none; the rami are indistinctly two-jointed and rather heavily armed with setae.

None of the chitin fragments of the sterna can be seen between the base of the legs, as noted in *C. bellottii* by Jungersen (1911, p. 13), and no furca or longitudinal ribs similar to those found in *Peroderma* by Richiardi.

Total length, not accounting for curves, 8 mm. Length of head, including processes and horns, 2.50 mm. Length of trunk, 7 mm.; diameter, 1.30 mm. Length of egg strings, 14 mm.

Color (preserved material), a uniform light yellow.

(*medusaeus*, medusa-like, alluding to the anterior processes.)

Internal anatomy.—The chitinogen layer of the body wall is somewhat thickened in the second, third, and fourth thorax segments, and also in the anterior end of the fifth segment. While there are no definite skin glands as in *Sarcotretes*, there are many large conical or funnel-shaped pores through the outer chitin layer in these regions, which communicate with the chitinogen cells and may well serve as excretory ducts (fig. 21).

Esophagus inclined ventrally to the axis of the head and opening into a stomach which is somewhat unsymmetrical as can be seen from figure 19, which has no convolutions, and which sends out no lateral processes. The ovaries are comparatively short and narrow, while the oviducts are very wide, filling nearly the whole cavity of the trunk (fig. 15).

The cement glands do not reach the anterior end of the oviducts, and are somewhat flattened dorsoventrally between the latter and the body wall, while the oviducts are a little flattened laterally.

Remarks.—This description is intended to supplement and in a few particulars to correct the one previously given. The former specimen was evidently injured on removing it from the fish. These two specimens were sent still attached to their host and were removed uninjured.

The characters which distinguish the species from Richiardi's *bellottii* are in the position and arrangement of the frontal processes and the posterior soft horns. In *bellottii* the frontal processes extend backward on the ventral surface a considerable distance beyond the base of the head and the soft posterior horns, while there is an additional pair of laminate processes or wings on the sides of the second thorax segment, as Richiardi stated.

In *medusaeus* the frontal processes only extend to the anterior margin of the posterior horns, the latter are distinctly on the cephalothorax, and there is nothing on the sides of the second thorax segment (fig. 18).

Moreover, in *medusaeus* there are no vestigial second maxillae anterior to the first legs, as noted by Jungersen for *bellottii*.[1]

The species found by Brian on *Myctophum affine* and referred to *medusaeus* appears to be correctly located, as will be seen by comparing his plate 10, figure 5, with plate 3, figure 15, of the present paper.

[1] Vidensk Meddel, fra den Naturh. Foren., vol. 64, 1911, p. 13, fig. 1, text, pl. 2, fig. 27.

CARDIODECTES BELLOTTII (Richiardi).

Plate 21, figs. 161 and 162.

Peroderma bellottii RICHIARDI, Atti della Soc. Tosc. Processi Verbali, vol. 3, 1882, p. 149.

Peroderma bellottii JUNGERSEN, Vid. Medd. fra den Naturh. Foren., Kiøbenhavn, vol. 64, 1911, pp. 11 and 13.

Host and record of specimens.—Two specimens of *Scopelus glacialis*, each infested with a single parasite of this species, were kindly sent to the author by Prof. F. E. Jungersen. They were collected by the Danish steamer *Thor* at the Straits of Gibraltar in 1910. One of the parasites was removed from its host, cleared, and mounted; the other, still attached to its host, has been placed in the United States National Museum, with Cat. No. 49701, U.S.N.M.

Specific characters of female.—Cephalothorax ellipsoidal, as wide as long, and smoothly rounded; soft horns on the anterior margin folded and turned inward toward each other; base of posterior horns extending across the second and onto the third thorax segment; each horn is flattened into a soft lamina, projecting ventrally, and somewhat enlarged at the tip; there is no division into lobes and no swollen spheres as in *medusaeus*.

Frontal processes longer than the others and projecting far in front of the head; those which radiate backward along the ventral surface of the head also project beyond the tips of the posterior soft horns; the entire mass of processes is thus an elongate ellipsoid, a little narrower anteriorly than posteriorly. The separate processes are considerably flattened, and are lobed and branched so that they closely resemble the fronds of the common seaweed *Fucus*.

The neck is bent twice as in *medusaeus*, first dorsally posterior to the base of the soft horns, and again ventrally behind the fourth legs.

Trunk cylindrical or somewhat spindle-shaped, being widest at the center and narrowing toward the posterior end; no lobes at the bases of the egg strings; abdomen hemispherical and inclined dorsally, less than a quarter of the diameter of the genital segment; egg strings one half wider than the abdomen and a quarter of the length of the entire body.

First and second antennae similar to those of *medusaeus;* proboscis somewhat larger, but apparently nonretractile; maxillae two-jointed and tipped with a small claw; maxillipeds rudimentary, consisting of a small basal joint tipped with a seta, and situated about halfway between the proboscis and the first swimming legs.

Four pairs of swimming legs, first two pairs biramose, rami two-jointed, third pair uniramose and two-jointed, fourth pair consist-

ing of only the basal joints, without rami or setae; first three pairs well armed with setae.

These legs are arranged like those of *medusaeus*, the first and second pairs close together, the second pair about opposite the center of the posterior soft horns, the third pair at a greater distance near the posterior margin of the third segment, the fourth pair at a still greater distance near the posterior end of the fourth segment.

Scattered chitin fragments which probably represent the original thoracic sterna are found in the spaces between the legs.

Color (preserved material), a uniform light yellow.

Total length, not estimating the curves, 6 mm. Length of head, including processes and horns, 2 mm. Length of trunk, 5 mm.; diameter, 1.15 mm. Length of egg strings, 1.50 mm.

(*bellottii*, to the Milanese ichthyologist, C. Bellotti.)

Internal anatomy.—The internal anatomy is very similar to that of *medusaeus*, with the following differences. The chitinogen layer is much thickened in the genital segment as well as in the anterior thorax segments. There are the same large conical or funnel-shaped pores in the outer skin, communicating with the inner chitinogen cells. The ovaries are somewhat longer and wider while the oviducts are not quite as wide, but the latter are still comparatively very wide and are flattened laterally like those in *medusaeus*. The cement glands are longer and reach in front of the anterior ends of the oviducts; they are cylindrical and are not flattened. These specific distinctions will supplement those already given under *medusaeus*, and may serve to establish the two species upon a more substantial basis.

Genus LERNAEENICUS Le Sueur.

Lernaea (part) SOWERBY, TURTON, BLAINVILLE, CUVIER, etc.

Lerneocera (part) BLAINVILLE, Journ. de Physique, vol. 95, 1822; *Lerneocera surriraiis*, third species, p. 376, a synonym for *Lernaeenicus sprattae*.

Lerneaenicus (part) LE SUEUR, Journ. Acad. Nat. Sci., Philadelphia, vol. 3, 1824, p. 289. Type *Lerneocera radiata* Le Sueur, second species.

Lernconema (part) MILNE EDWARDS, Hist. Nat. des Crustacés, 1840, vol. 3, p. 524; *L. monillaris*, second species, p. 525, a synonym for *Lernaeenicus sprattae*.

Foroculum WM. THOMPSON, Cat. Museum College of Surgeons, 1843; *Foroculum sprattae*, single species, a synonym of *Lernaeenicus sprattae*.

Lerneaenicus FOWLER, Report New Jersey State Museum for 1911 (1913), p. 87.

External generic characters of female.—Head not separated from the thorax, in line with the body axis, or bent forward at right angles, with a deeply buried tripartite eye over the base of the esophagus; horns slender, cylindrical, chitinous, 2 to 10 in number, simple or branched; anterior thorax enlarged through the bases of the swim-

ming legs, then becoming filiform and chitinous, twisted and usually flexed; trunk cylindrical and straight; abdomen straight, narrower than trunk and of varying lengths; anal laminae minute and destitute of setae; egg strings filiform and very long, eggs uniseriate and strongly flattened. Two pairs of antennae, second pair chelate; proboscis large and extensile; mandibles without teeth; one pair of maxillae, no maxillipeds; four pairs of swimming legs close together behind the head, first two pairs biramose, third and fourth pairs uniramose.

Internal generic characters of female.—Esophagus short, straight, and inclined to the body axis; stomach without lateral lobes but with one or two convolutions, passing insensibly into the intestine, which is very narrow in the neck, but wider than the stomach in the trunk, abruptly contracted at the posterior end of the abdomen into a narnow rectum; ovaries paired, short, wide, and strongly flattened between the intestine and the dorsal body wall at the anterior end of the trunk; oviducts passing around the intestine to the ventral surface and then straight back to the vulvae, eggs tightly packed like a row of coins; cement glands slender, cylindrical.

Genus habitat.—This is a genus of muscle borers; they penetrate from the outside surface of the host's body into the underlying tissues, sometimes from the throat, sometimes from the sides of the body, sometimes from the vicinity of the fins. In some species there are peculiar frontal processes by means of which they fasten themselves to a bone, but they are usually anchored by the cephalic horns, and a cyst is formed around the horns, the head, and the anterior neck.

Type of the genus.—Lernaeenicus radiatus Le Sueur, type by elimination.

(*Lernaeenicus*, *Lernaea*, and *enico*, to torment or torture.)

KEY TO THE SPECIES OF THE GENUS LERNAEENICUS.

1. 3 to 9 or 10 horns, cylindrical, chitinous, branched 2
1. Only 2 horns, a lateral pair, short and unbranched 3
1. No horns, but instead 2 or 3 small and soft knobs 4
2. Horns usually 5, arranged radially in one set; head in line with thorax; no attachment plates (40 mm.)[1] ..... *radiatus* Le Sueur, 1824, p. 59.
2. Horns in two sets, one at posterior end of head, the other behind the fourth legs; head at right angles to thorax; four attachment plates in front of antennae (12 mm.) ..... *polyceraus*, new species, p. 62.
2. Horns, 3, triangular or conical, in one set; no attachment plates; head at right angles to thorax (13 mm.) ..... *encrasicholi* (Turton), 1807.
3. Horns pointed backward; no attachment plates in front of antennae; neck often moniliform (25 mm.) ..... *sprattae* (Sowerby), 1804.
3. Horns pointed laterally; four attachment plates in front of antennae; neck never moniliform (25 mm.) ..... *affixus*, new species, p. 64.

[1] Average total length of species.

4. Abdomen more than half the length of the trunk 5
4. Abdomen short and blunt 6
5. Posterior horn half the length of the head, lateral horns much shorter; abdomen twice the length of the trunk. (45 mm.)
longiventris, new species, p. 66.
5. Posterior and lateral horns the same length; abdomen a little longer than the genital segment (70 mm.) ..... *procerus* (Leidy), 1888, p. 69.
5. Posterior and lateral horns the same length as the head; abdomen as long as the genital segment (50 mm.) ..... *vorax* Richiardi, 1877.
5. Posterior and lateral horns one-third the length of the head; abdomen much shorter than genital segment (70 mm.) ..... *polynemi* Bassett-Smith, 1898.
6. Head subtriangular, with no lateral horns, but with a single dorsal tubercle; neck three times the length of the trunk; abdomen very minute (28 mm.)
gracilis Heller, 1865.
6. Head hastate, bluntly pointed anteriorly; two lateral and a dorsal knob; neck shorter than the trunk; abdomen of medium size (40 mm.)
sardinae Baudouin, 1904.
6. Head club-shaped, with lateral but no dorsal knobs; abdomen lacking, the trunk ending in a point (60 mm.) ..... *lesueurii* Milne Edwards, 1840.

Remarks.—Three species, *abdominalis* Milne Edwards, 1840, *labracis* and *sargi* Richiardi, 1880, ascribed to this genus have never been figured, and the last two have not even been described, so they are of necessity omitted.

Four species, *inflexus* and *nodicornis* Steenstrup and Lütken, 1861, *gempyli* Horst, 1878, and *eristaliformis* Brian, 1912, are transferred to the new genus *Sarcotretes* established by Jungersen in 1911. With reference to the horns we may notice that in the genus *Lernaea* they are always soft, while in *Lernaeenicus* those of the first two species in the key (*radiatus* and *polyceraus*) are as chitinous as in *Lernaeocera*, those of *sprattae* and *affixus* are only partially chitinized, while the horns, or better, the knobs of the remaining species are usually soft.

The two species, *vorax* and *neglectus*, described and figured by Richiardi in 1877, are probably identical. The only difference which Richiardi could find in them was that *neglectus* averaged only two-thirds the size of *vorax*. He himself said of the former species, "It is impossible to find in its general form any characters which will distinguish it from *vorax*. It does not differ in the form and position of the antennae, the buccal apparatus, the maxillipeds, the number and conformation of the segments or in the form of young individuals, and hence in the progressive deformation of the testa as also in the mode of attachment to the body of the host" (p. 206). In other words, we have to conclude that it does not differ at all, but is the same species and hence *neglectus* is made a synonym of *vorax*. In his profile view Richiardi represented the eye of *vorax* as actually protruding from the dorsal surface of the head.

In all the species examined by the present author the eye is just above the esophagus and a considerable distance beneath the dorsal surface, as is shown in figure 69.

In dealing with this genus Fowler[1] said in the key to the genera of the Lernaeidae (p. 86):

"b. No vestiges of feet on under surface of body, nor any appendages representing them ---------- *Lerneaenicus.*"

and again (p. 87), in the genus diagnosis of *Lernaeenicus*, "Thoracic limbs placed close together just behind head, first two biramose, third and fourth uniramose, and all with two joints." The latter of course is the correct statement. The spelling "*Lerneaenicus*" is too obviously a printer's error to be worthy of a second thought.

LERNAEENICUS RADIATUS LeSueur.

Plate 4, figs. 24–35, plate 5, figs. 36–41.

Lernecocera radiata LESUEUR, Journ. Acad. Nat. Sci. Philadelphia, vol. 3, 1824, p. 288, pl. 11, fig. 1. The new genus *Lernaeenicus* proposed, p. 289.

Lernea radiata DE KAY, New York Fauna, Crustacea, vol. 6, 1844, p. 60.

Lerneonema radiata S. I. SMITH, Rep. Comm. Fish. for 1871 and 2, p. 578 (284), pl. 7, fig. 30.

Lernaconema radiata R. RATHBUN, Proc. U. S. Nat. Mus., vol. 7, 1884, p. 491.

Lerneocercopsis septemramosus FOWLER, Rep. N. J. State Museum, 1911 (1913), p. 92, pl. 24.

Lerneaenicus radiatus FOWLER, Rep. N. J. State Museum, 1911 (1913), p. 87, pl. 21; Proc. Acad. Nat. Sci. Philadelphia, vol. 65, 1913, p. 62.

Host and record of specimens.—There are in the United States National Museum collection 48 vials containing specimens of this species as follows: From the tomcod, *Microgadus tomcod*, Cat. Nos. 6146, 8283, 8285, 8687, 12298, 12299, 12300, 38025, 42318, 42321, 42338, 42339; from the menhaden, *Brevoortia tyrannus*, Cat Nos. 6001, 6002, 6063, 8282, 11617, 18369, 42323, 42331, 42337, 42345, 47790, 47791; from the killifish, *Fundulus heteroclitus*, Cat. Nos. 42311, 42317, 42335, 42343, all so far mentioned taken at Woods Hole, Mass.; from the eel, *Anguilla bostonensis*, Cat. No. 12293 from Woods Hole, and Cat. No. 42322 from Charleston, South Carolina; from the bluefish, *Pomatomus saltatrix*, at Woods Hole, Cat. No. 47787; from the glut herring, *Pomolobus aestivalis*, at Woods Hole, Cat No. 12313; from the shad, *Alosa sapidissima*, no locality, Cat No. 47789; from the oldwife, *Leiostomus xanthurus*, at Beaufort, North Carolina, Cat. No. 47788; from the smelt, *Osmerus mordax*, at Woods Hole, Cat No. 42350; from the hake, *Urophycis tenuis*, at Woods Hole, Cat. Nos.

[1] Crustacea of New Jersey, 1913.

12303 and 12304; from the alewife, *Pomolobus pseudoharengus*, at Woods Hole, Cat Nos. 13069 and 42327; from the pursey minnow, *Cyprinodon variegatus*, at Woods Hole, Cat. No. 8287; from the anchovy, "*Engraulis vittatus*," in New York City market, Cat. No. 42349; from the white perch, *Morone americana*, at Woods Hole, Cat. Nos. 8286 and 8288; no host and no locality given, Cat. Nos. 6176 and 35252.

The eight specimens in lot No. 12313 are heavily infested with algae, but were removed from their host with exceptional care and are finely preserved. Since Le Sueur's original specimens have been lost these may well serve as surrogate types of the species.

Specific characters of female.—General body form elongate slender, and graceful, the three body regions distinctly separated. Head terminal and globular, with a conical proboscis as large as itself attached to the ventral surface at right angles to the long axis. Cephalothorax furnished with slender, filamentous, radiating chitin horns, usually five in number and unbranched. But there may be any number of these horns from 2 to 9; when there are only two they are on a level with the dorsal surface at the extreme anterior end of the head (fig. 29); when there are five they are arranged radiately around this portion of the head like the spokes of a wheel (fig. 27). But there may also be a smaller horn on either side of the base of the second antennae, and two others, one on either side of the thorax, on a level with the dorsal surface and opposite the fourth pair of legs (figs 28 and 40). These horns may be of any length or they may be reduced to mere knobs. When there are five, the typical number, they are nearly equal and are arranged one dorsal, two lateral, and two latero-ventral. When they differ in length the two lateral are usually the longest and the dorsal one the shortest.

The free thorax or neck is somewhat enlarged immediately behind the head through the bases of the legs, then quickly becomes filiform and has the same diameter back to the trunk. The latter is elongate-conical, the point of the cone at the base of the neck, the outer surface smooth and without any traces of segmentation. Normally a section of this trunk would present a circular outline, but in preserved material it often becomes flattened laterally. The egg strings are the same diameter as the neck and one-half longer than the body. In immature specimens the trunk is greatly reduced in length and width, while the neck is proportionally increased in length, and the egg strings then are often three times the length of the whole body (fig. 26). The abdomen is a short, stout, and blunty rounded cone, on a level with the dorsal surface of the genital segment, one-third the length and three-fourths the width of the latter, and destitute of anal laminae or setae.

The first antennae are short, slender, cylindrical, and three-jointed, sparingly armed with setae, one at the tip of the distal joint and one on the side of the second joint. The second antennae project from the anterior margin of the head on either side of a short and pointed rostrum. They are long, stout, and two-jointed, the joints about the same length, the distal one ending in a stout chela, the claw shutting down past a spiny projection on the inner side of the distal joint.

Proboscis a bluntly rounded cone, soft and fleshy in texture, as large at the base as the whole ventral surface of the head, and constricted at about the center of its length. It is well supplied with striated muscles, by means of which it can be protruded and withdrawn, or moved from side to side. At the tip there is a large lobe on either side and a central oval plate on the ventral surface. This plate is convex ventrally and covered at the center with minute three-cornered spines. Above this plate and between the lateral lobes the slender cylindrical mouth-tube projects a short distance. This is a very thin-walled, transparent tube, wrinkled transversely, and held open by circular chitin ribs. It flares somewhat at the tip, where it is surrounded by a delicately scalloped membrane. It is extensile and can also be moved from side to side independently of the rest of the proboscis.

On either side of the base of the ventral plate is a maxilla, which is three-jointed, the terminal joint narrower and longer than the other two, which are about equal. At the outer distal corner of the basal joint is a short spine; the terminal joint ends in a short, stout, and blunt claw.

The swimming legs each consist of flattened oval basal plate and very short and blunt rami, destitute of setae; the first two pairs are biramose, the last two pairs uniramose.

Color.—The head and proboscis are a deep fish-blood red when freshly taken from the host, the neck a light horn color slightly greenish, the central digestive canal more or less red when filled with blood; trunk dark red internally, surrounded by the yellowish-white ovaries and oviducts; egg strings a light greenish yellow.

Entire length, without egg strings, 40 mm. Length of trunk, 20 mm. Diameter of trunk, 1.50 mm. Greatest spread of horns, 6 mm. Length of egg strings, 28 mm.

(*radiatus*, radiate, alluding to the usual arrangement of the horns.)

Remarks.—The beautiful figures illustrating this species were drawn some time ago by Richard Rathbun, now assistant secretary in charge of the Smithsonian Institution, and were generously turned over to the present author together with valuable notes and de-

tailed descriptions, so that the present account must be credited to him practically in its entirety.

The two figures of the adult female were drawn by J. H. Blake and are by far the best that have ever appeared of the species, since they show a wealth of detail which is specifically accurate.

Mr. V. N. Edwards of the Bureau of Fisheries' station at Woods Hole, who collected most of the specimens of this species mentioned above, told the author that it was very common in the spring when menhaden are abundant, but is found only occasionally during the summer when these fish are much less plentiful.

The parasite is found on the sides and back of its host, usually not far from, and often quite close to, the dorsal fin, and is sometimes attached to the throat under the tongue, or to the edges of the operculum. They bury deeply in the flesh, with the cephalic horns wrapped around some portion of the bony framework of the fish, or held firmly between two bony plates of the operculum, and they make a bad sore.

The species can be readily recognized by the radiating cephalic horns, the large fleshy proboscis, and the projecting second antennae, which stand out prominently from the anterior margin of the head. The number of horns as well as their arrangement varies considerably, but a careful examination of all the oddities in the 200 specimens belonging to the United States National Museum failed to reveal a single one that could be separated specifically. They all possessed the same large fleshy proboscis, projecting second antennae, and swimming legs.

Consequently the new genus "*Lerneoceropsis*" proposed by Fowler in his Crustacea of New Jersey (p. 92) can hardly stand, since the only point in which it differed from *raditaus* was in the possession of two extra horns on the sides of the neck. There are at least a dozen such specimens in the National Museum collection from the same host that Fowler mentioned, but every one of them belongs to the present species. Furthermore, Fowler's specimens show their likeness ("opsis") not to *Lernaeocera* but to *Lernaeenicus*.

LERNAEENICUS POLYCERAUS, new species.

Plate 5, figs. 42–47.

Host and record of specimens.—Two specimens were obtained from the red goat fish, *Upeneus maculatus* by Dr. Edwin Linton at Beaufort, North Carolina, in 1902, and are numbered Cat. No. 47807, U.S.N.M. A third specimen was obtained by Mr. V. N. Edwards from the tomcod, *Microgadus tomcod*, at Woods Hole in 1885. It has been given Cat. No. 6147, U.S.N.M., and is made the type of the species, the two others becoming paratypes.

Specific characters of female.—General form comparatively short and stout; head bent forward at right angles to the thorax, with four attachment plates at its anterior end, in front of the antennae; a pair of long, branched lateral horns at the posterior end of the head; two other lateral and a posterior horn, all dichotomously branched, on the thorax behind the fourth legs; thorax much widened between the two sets of horns; neck comparatively thick, flexed behind the horns and again where it joins the body; trunk a short ellipsoid, slightly flattened laterally; abdomen three-fifths the diameter of the trunk and nearly the same length, somewhat enlarged through the center; egg strings the same diameter as the neck and longer than the trunk.

First antennae minute, three-jointed, sparsely armed with setae; second pair two-jointed and chelate; four attachment plates like those in *affixus*, but each is deeply bilobed and the distal margins curl over inwards.

Maxillae small and three-jointed, the terminal claw short and blunt; proboscis large and long, protruded from the ventral surface of the head and parallel with the axis of the thorax; two large lateral lobes at the tip, but no ventral plate visible; mouth-tube much swollen between the lateral lobes, then abruptly contracted to less than half the basal diameter; first three pairs of legs with a single ramus indistinctly segmented, the fourth legs without a ramus.

Color (preserved material).—Neck and horns a yellowish cartilage-gray; head red from the contained blood; body and egg strings a brownish yellow.

Total length, without egg strings, 12 mm. Length of head and neck, 6 mm.; of trunk, 3 mm.; of abdomen, 3 mm.; of egg strings, 8.50 mm. Greatest diameter of the trunk, 1 mm.

(*polyceraus*, πολύς, many, and κέρας, a horn.)

Remarks.—Doctor Linton recorded in his notes that this species was attached to the gill cover of its host and that the surrounding tissues were congested and inflamed. The single goatfish from which his specimens were obtained was the only one examined by him, so there are no data as to the abundance of the species. It will be seen that this species resembles *radiatus* in the number and hardness of its horns and *affixus* in the possession of attachment plates, but its general makeup and the details of the appendages are quite different from both.

In general it may be recognized by its small size and its short and stout trunk, the abdomen being as long as the genital segment.

LERNAEENICUS AFFIXUS, new species.

Plate 6, figs. 48–61.

Host and record of specimens.—The tomcod, *Microgadus tomcod*, seems to be the most frequent host of this species, and the United States National Museum collection contains the following series of specimens obtained at Woods Hole, Massachusetts. A single female to serve as the type of the new species, Cat. No. 47792; a dozen females, Cat. No. 12311; 8 entire tomcod heads, with about 50 parasites attached, Cat. No. 47797; 8 tomcod heads, with 100 parasites attached, Cat. No. 47798; 40 females from the same host, at Fire Island Beach, Long Island, Cat. No. 35982; 8 females, Cat. No. 47794.

It has also been found upon a few other hosts—three vials, containing 2, 3, and 8 specimens, respectively, from the killifish, *Fundulus heteroclitus*, with Cat. Nos. 47793, 47795, and 47796; a single female from the white perch, *Morone americana*, Cat. No. 12301; two females from the glut herring, *Pomolobus aestivalis*, Cat. No. 42296.

Specific characters of female.—General body form very similar to *radiatus*, with the three regions as distinctly separated; head turned ventrally at right angles to the thorax, cylindrical, slightly larger at the base and tip than in the center. No horns on the head, but a single pair, short and unbranched, on the sides of the thorax opposite the fourth legs; occasionally these horns may be branched, and rarely there is a second pair posterior to the first, which are reduced to mere stumps.

This species attaches itself to a bone, and hence the horns are not used for anchorage. The organ of fixation is on the anterior end of the head, just in front of the second antennae, and is made up of two lamellae on either side, whose bases are attached along the midline of the front of the head. At their bases these lamellae lie flat upon the surface of the head and point away from each other; they then gradually curve forward until their tips are parallel, thus assuming the shape of half a cylinder.

The anterior surface of the lamellae or the inside of the half cylinder is applied directly to the bone, and cements itself so firmly to the latter that the two can be separated only by cutting, the long axis of the bone being parallel with the body axis of the copepod.

The edges of the lamallae are often thickened to make the fastening more secure. The thorax, genital segment, and abdomen are like those of *radiatus*, except that the trunk is relatively longer and wider, being from 10 to 15 times the diameter of the neck. The egg strings are about one-third the diameter of the trunk and a little longer, and are usually fairly straight. First antennae short and stout, two-jointed, with two small spines on the terminal joint; sec-

ond antennae one-jointed, the joint long and conical and furnished on the inner margin with a cup-shaped socket, into which the tip of the stout and strongly curved terminal claw shuts, forming a chela. Proboscis long and narrow and parallel with the body axis in consequence of the turning forward of the head; it is shorter and much narrower than in *radiatus*, and is not constricted at the center. It terminates similarly in a pair of large dorso-lateral lobes and a subquadrangular plate, from under whose base project the maxillae. These are two-jointed, the basal joint the stouter and the longer, and armed on its anterior margin near the center with a short spine.

The terminal joint is much shorter and narrower and is somewhat enlarged at the distal end, to which is hinged the short and strongly curved claw. First two pairs of swimming legs with triangular basal plates carrying two rudimentary rami; third pair with an elliptical basal plate, reduced in size and carrying but one ramus; fourth pair with an elliptical basal plate, still further reduced and without any ramus.

The anal laminae are greatly reduced in size also, and consist of tiny knobs, one on either side of the anus, and destitute of setae.

Color (preserved material), a uniform orange yellow; the head, neck, and egg strings brownish, the body often spotted with brown.

Total length without egg strings, 20 to 30 mm. Length of trunk, 12 to 18 mm.; diameter, 1.50 mm. Length of egg strings, 15 to 20 mm.

(*affixus*, fastened or attached, that is, to a bone.)

Remarks.—This species seems to be a parasite chiefly of the tomcod, which it often infests in great numbers (see tables, p. 12). Its favorite point of attachment is on the isthmus of the fish's throat, between the opercula, but it is also often found along the ventral margins of the opercula. It can be readily recognized by the fact that it is always attached by the front of the head to a bone, and this one character will separate it from *radiatus* when, as often happens, the two are found together upon the same fish. Further distinctions are the attachment lamellae, the forward flexure of the cephalothorax, and the very short horns, only two in number. From *polyceraus*, which also possesses attachment lamellae and a forward flexure of the head, it may be distinguished by its larger size, by the relatively longer and narrower trunk, and by the one pair of unbranched horns instead of two pairs of branched ones.

The bunching of this parasite on the throat of the tomcod is remarkable, three or four of them often using the same opening through the skin of the fish, but attaching themselves to different bones and showing great differences in both the direction and amount of torsion (see p. 15).

LERNAEENICUS LONGIVENTRIS, new species.

Plate 7, figs. 62–70.

Host and record of specimens.—The collection of the National Museum contains 15 vials of this species from widely different hosts and localities, as follows:

Specimens.	Host.	Locality.	Cat. No., U.S.N.M.
1 female	*Caranx crysos*	New England coast	2107
Do	*Palinurichthys perciformis.*	Woods Hole	6058
Do	*Pomatomus saltatrix*	Long Island Sound	6190
Do	*Cybium maculatum*	Woods Hole	6192
2 females	*Caranx* species	Vineyard Sound	6194
3 females	*Caranx crysos*	Woods Hole	19727
Do	*Pomatomus saltatrix*	do	42312
1 female	*Caranx hippos*	do	42346
1 female type	Dolphin	Atlantic Ocean	47800
7 females	*Coryphaena equisetis*	Beaufort, North Carolina.	47801
2 females	*Scomberomorus maculatus.*	Woods Hole	47802
Do	*Mugil cephalus*	Beaufort, North Carolina.	47803
3 females	*Caranx crysos*	do	47804
2 females	do	Woods Hole	47805
12 females	Dolphin	Atlantic Ocean	47806

Specific characters of female.—Cephalothorax smoothly rounded and elongated at right angles to the body axis, without horns but with three protuberances or knobs. One of these is median, projecting from the posterior end of the cephalothorax and in line with it, about two-thirds its length and half its diameter. The other two are lateral, one on either side opposite the base of the larger median knob, and are short and wide, little more than a slight swelling or tubercle.

The neck is long and narrow, but relatively much thicker than in *radiatus*, nearly straight and decreasing in diameter to the point where it joins the trunk. The latter widens abruptly from this narrowed point and is cylindrical; the portion representing the genital segment is of the same diameter throughout and about one-quarter as long as the neck. To its posterior end is attached the abdomen, which is cylindrical, of the same diameter as the egg strings, and nearly twice as long as the genital segment; the anal laminae are minute and destitute of setae.

The egg strings are one-third the diameter of the genital segment and but little longer than the abdomen. As they approach ripeness the embryos are colored a beautiful maroon, and this gradually becomes more apparent in the strings.

The first antennae are turned back along the surface of the head and are indistinctly three-jointed, the terminal joint chelate, a strongly curved claw shutting down against a short projection on the inner margin of the second joint. The basal joint is a trifle wider and nearly twice as long as the second joint. There is apparently no protrusible proboscis, since none can be seen in any of the specimens, but fortunately those from Beaufort, North Carolina, were examined alive and a proboscis could then be seen projecting from the ventral surface. The numerous muscles also connected with the mouth opening must be used for protrusion and retraction. And sections of the head of one of these preserved specimens show clearly that the only reason why no proboscis is seen is that it was tightly withdrawn into the head at the time of death. The mouth is a simple opening and is surrounded by a narrow and ciliated membrane. On the inside of the mouth tube and projecting from its dorsal surface into the lumen can be seen two large and stout spines, bipartite near their tip, which probably represent rudimentary mandibles. On either side of the mouth are the maxillae, which are two-jointed, the basal joint stouter than the terminal and nearly twice as long, somewhat swollen at the center, and armed on its ventral surface with two short knobs placed side by side; the terminal joint is tipped with a rather stout claw, longer than the joint itself and slightly curved.

Upon the ventral surface of the neck where it joins the head are the four pairs of swimming legs. These diminish in size regularly backward, the first two pairs being biramose and the last two pairs uniramose, all the rami two-jointed. The basal plates are broadly triangular, the base of the triangle jointed to the thorax, while to the apex are attached the rami. The joints of these rami are of about the same size and the terminal one is tipped with seven setae, the central three of which are considerably longer than the others.

Internal structure.—Inside of the anterior end of the genital segment may be seen the ovaries, which are strongly flattened between the intestine and the dorsal wall of the segment. They are oval in outline, the broad ends anterior, from which the oviducts extend obliquely downward and backward to the ventral surface. There they increase in diameter, become straight and cylindrical, and extend back to the vulvae. The cement glands are straight and narrow and do not show any segmentation; the duct is about the same length as the glandular portion.

The esophagus is slightly enlarged at either end and contracted at the center; the anterior enlargement is probably temporary and due to the pulling up of the dorsal wall during retraction; the posterior enlargement is permanent. The stomach is narrow and at its posterior end, where it passes into the neck, it is bent at right angles. The intestine fills the whole lumen of the neck and abdomen.

but in the genital segment, where it is somewhat enlarged, it lies near the dorsal surface and leaves room for the oviducts and cement glands.

Color a dull, yellowish-white, often becoming transparent in the neck and abdomen, head a bright pink red, egg strings a beautiful maroon on ripening; large blotches of the same maroon on the basal joints of the legs, the rows thus formed continued forward onto the head; oviducts dark brown.

Total length, excluding egg strings, 40 to 50 mm. Length of head, 2.35 mm.; of neck, 25 mm.; of genital segment, 5.50 mm.; of abdomen, 10 mm.; of egg strings, 13 mm. Diameter of neck, 0.45 mm.; of genital segment, 1.30 mm.; of abdomen, 0.35 mm.; of egg strings, 0.30 mm.

(*longiventris*, *longus*, long and *venter*, abdomen.)

Nauplius.—Body spindle-shaped, the posterior half considerably narrower than the anterior, both ends evenly rounded, the length to the width at the center as 10 to 7. The eye spot is comparatively large and shaped like the section of an ordinary T rail. There are four color spots, a large one at the center on either side close to the lateral margin and a pair of smaller ones near the posterior end, each about half way between the margin and the midline. These four and the eye spot are the same rich maroon red as is found on the basal joints of the legs of the adult.

In the center of the body are oil globules, sometimes a single large spherical one filling the whole center, as in figure 70, sometimes a pair of smaller ones with their adjacent sides flattened along the midline.

Occasionally there is a group of small drops irregularly disposed, but always chiefly at the center. The balancers are large and stout, and are curved forward on either side.

Length, 0.25 mm.; width at the center, 0.175 mm.

Remarks.—This species was first found upon the crevalle or hard tail, *Caranx crysos*, the genital segment and egg strings showing on one side or the other of the dorsal or ventral fin near the tail. Afterwards a single specimen was taken from the operculum of the common mullet, *Mugil cephalus*, and several specimens near the dorsal and anal fins of the small dolphin, *Coryphaena equisetus*. The head is buried in the tissues close to the backbone, where it forms a fibrous membrane or sheath, very tough and fitting so tightly that it is difficult to remove it without injury to the head of the parasite. The neck is contractile and upon irritation can be withdrawn, pulling half or two-thirds of the genital segment in with it. When the irritation stops the body returns to its normal position. The species is not at all common and only a single specimen has been found upon any fish.

The only other species which closely resembles it is *polynemi* Bassett-Smith, but in that species the head is in line with the neck instead of at right angles to it, the basal joints of the legs are narrow-oblong instead of triangular and have no pigment spots, the abdomen is shorter than the genital segment, while the egg strings are two or three times as long as the abdomen and bright green in color.

LERNAEENICUS PROCERUS (Leidy).

Lernæonema procera LEIDY, Proc. Acad. Nat. Sci. Phila., 1888, p. 165.—FOWLER, Report of New Jersey State Museum, 1911 (1913), p. 125.

Host and record of specimens.—Several of these parasites were obtained by Leidy from the shark, *Carcharias littoralis*, caught at Beeseleys Point, New Jersey. They were hanging from the upper lip on either side of the mouth, and were thickly covered with hydroids, *Eucope parasitica.*

Specific characters of female.—Head horizontal, semioval, convex above, with three short and blunt occipital tubercles; anterior part well rounded, excavated beneath and inclosing the mouth, antennae, and maxillipeds; neck long, linear, and cylindrical; trunk short, fusiform, and truncated posteriorly; abdomen longer than the genital segment, linear, cylindrical; egg strings long, linear, and cylindrical.

Color, a uniform pale yellow.

Total length, 70 mm.; including the egg strings, 90 mm. Length of head, 3 mm.; of neck, 30 to 45 mm.; of genital segment, 10 to 12 mm.; of abdomen, 12 to 15 mm.; of egg strings, 20 mm. Diameter of neck, 0.375 mm.; of genital segment, 1.75 mm.; of abdomen, 0.50 mm.; of egg strings, 0.25 mm.

(*procerus*, long.)

Remarks.—This parasite is known only from Leidy's description and the original specimens have been lost. Fowler in the reference given above repeated Leidy's description, placing the species for some unaccountable reason in the family of the Ergasilidae, although he speaks of the parasites as "lerneans." Since the original specimens are lost we must be guided by the above description (no figures were published) and the species must remain as Leidy left it until rediscovered at some future time. It is closely related to *longiventris*, *vorax*, and *polynemi*, but does not agree well enough with either of them to be identified with it.

Genus SARCOTRETES Jungersen.

Sarcotretes JUNGERSEN, Vidensk. Meddel. fra naturh. Foren., vol. 64, 1911, 33 pages, 2 plates, 6 text figures.

External generic characters of female.—Cephalothorax in line with the body axis and considerably enlarged; eye so deeply buried as to be invisible; two lateral horns ventral to the carapace, large,

soft, and thin-walled; dorsal carapace and two or three anterior terga and sterna often fully preserved; neck constricted just behind the horns, then enlarged and constricted again into a narrow chitin stalk where it joins the trunk and usually flexed; trunk claviform with a minute abdomen on the dorsal surface; egg strings long, straight, and uniseriate.

Two pairs of antennae, second pair chelate; mandibles spine-like and without teeth; two pairs of maxillae; three pairs of swimming legs, first two pairs biramose, third pair uniramose, all the rami two-jointed and armed with setae.

Internal generic characters of female.—Esophagus in line with body axis and nearly straight; anterior stomach neither lobed nor convoluted; intestine enlarged in the anterior neck, then constricted through the narrow stalk, enlarged again and flattened dorso-ventrally in the trunk, and abruptly constricted at the posterior end into a short rectum.

Ovaries paired and dorsal to the intestine at the anterior end of the trunk, only a little flattened; oviducts nearly straight and much wider than the ovaries or intestine; cement glands not reaching the anterior ends of the oviducts, glandular portion shorter than the ducts and not segmented. Chitinogen layer of the skin especially well developed at the anterior and posterior ends of the genital segment; a longitudinal row of skin glands along either side of the ventral surface, some distance from the midline.

Genus habitat.—This genus burrows into the cephalic or cephalothoracic muscles of its host and brings its head in contact with the apophysis of the vertebral column. The head and enlarged portion of the neck are surrounded by a cyst formed in the tissues of the fish.

External generic characters of Copepodid male (genus *Sarcotretes*).—Head and first thorax segment fused into a cylindrical cephalothorax, three times as long as wide; second, third, and fourth thorax segments free; fifth and genital segments and abdomen indistinguishably fused and without lobes; anal laminae short and wide, each armed with four or five minute, nonplumose setae. First antennae with indistinct joints; second antennae two-jointed and chelate; mouth tube conical, at right angles to the axis of the head; mandible a single slender spine; first maxilla a fingerlike process, without joints; second maxilla uncinate; maxilliped reduced to a mere knob; three pairs of swimming legs, first and second pairs biramose, rami indistinctly two-jointed, third pair uniramose, without joints.

Type of the genus.—*Sarcotretes scopeli* Jungersen, monotypic.

(*Sarcotretes*, Σάρξ, flesh, and τρητής, a borer or piercer.)

KEY TO THE SPECIES.

1. Neck but little enlarged anteriorly and not flexed; lateral horns at right angles to the body axis 2
1. Neck much enlarged anteriorly, then constricted and flexed at the constriction; tips of the horns turned backwards 3
2. Lateral horns swollen and bluntly rounded; proboscis conical and strongly tapered (49 mm.)[1] ..... *nodicornis* (Steenstrup and Lütken), 1861.
2. Lateral horns cylindrical and sharply pointed; proboscis cylindrical or spherical (85 mm.) ..... *gempyli* (Horst), 1878.
3. Proboscis short and fully as wide as long; carapace, terga, and sterna distinctly visible 4
3. Proboscis twice as long as wide; no carapace, terga, nor sterna visible (26 mm.) ..... *inflexus* (Steenstrup and Lütken), 1861.
4. No constriction behind the legs; mouth tube turned ventrally; rami of legs armed with setae (13 mm.) ..... *scopeli* Jungersen, 1911.
4. A marked constriction behind the legs; mouth tube in line with head; rami of legs without setae (44.50 mm.) ..... *cristaliformis* (Brian), 1912.
4. No constriction behind the legs; mouth tube in line with head; upper lip bilobed (22 mm.) ..... *lobatus*, new species, p. 72.

Remarks.—The only reason given by Jungersen for establishing the present genus was the fact that it possessed but three pairs of swimming legs, while the closely allied genera possess four pairs. There are, however, several other characters of equal or greater value, such as externally the presence of first maxillae on the sides of the mouth tube in front of the second pair, the softening of the horns and the anterior portion of the thorax, and the persistence of the larval carapace, terga, and sterna.

Internally there is the peculiar arrangement and character of the chitinogen layer of the body wall, which covers the inner surface of the neck as well as the genital segment, the wheel-like skin glands, and the dorso-ventral flattening of the intestine. Taken accumulatively these characters establish the genus beyond any dispute, and there should be transferred to it such species as show these characters, or a convincing majority of them. Accordingly that has been done in the key above given. It is worthy of note that Steenstrup and Lütken recognized that the species described by them differed materially from the *Lernaeenicus* type, and suggested in a footnote the possibility of a subsequent generic separation. Horst stated definitely that his species had but three pairs of legs and an extra pair of mouth-parts, while the "hard chitin parts of the cephalothorax" which he mentioned were probably the persistent carapace, sterna, and terga. Brian showed the same details in the excellent figures of his species, all of which have been confirmed upon a specimen in the United States National Museum collection (see p. 72).

Furthermore this species is not gregarious like *Lernaeenicus* but is solitary, only a single specimen being found upon a host.

[1] Average total length of species.

Doctor Jungersen very kindly presented the author with a fine specimen of his species, *Sarcotretes scopeli*, which has been of great service for comparison.

SARCOTRETES ERISTALIFORMIS (Brian).

Lernaeenicus cristaliformis BRIAN, Copépodes parasites des Poissons et des Échinides provenant des campagnes scientifiques de S. A. S. le Prince Albert I^{er} de Monaco, 1912, p. 20, pl. 4, figs. 1 and 2; pl. 9 and 10.

Host and record of specimens.—A single female was obtained from *Gastrostomus bairdii* by the Bureau of Fisheries steamer *Albatross* at station 2206, off the coast of New Jersey, in August, 1884. It has been given Cat. No. 8349, U.S.N.M.

Remarks.—This specimen is somewhat injured but not enough to affect its identification. It agrees in every particular with the two large specimens so fully and excellently described by Brian. And it was even obtained from the same host, a rare deep-sea Eupharyngid, but from a different locality. It exceeds Brian's specimens somewhat in size, the trunk measuring 33 mm. in length and the neck and cephalothorax 25 mm.; this latter portion of the body has shriveled somewhat in the preservative and was probably a few millimeters longer when taken from the fish.

SARCOTRETES LOBATUS, new species.

Plate 8, figs. 71–79.

Host and record of specimens.—Two specimens were obtained from *Benthosema* (*Scopelus*) *mulleri* in slightly different localities, one by the Fisheries steamer *Fish Hawk* in 1882 at station 1140 off Marthas Vineyard, the other by the Fisheries steamer *Albatross* in 1883 at station 2001 off Block Island. The former has been given Cat. No. 6123, U.S.N.M., and is made the type of the species, the latter was cleared in clove oil for the internal anatomy.

External specific characters of female.—Cephalothorax short, cylindrical, and strongly inflated, covered dorsally with a well-defined carapace, and sending out on either side a large cushionlike process or horn, which curves posteriorly and ends in a sharp point; combined width of head and horns much greater than the length. Neck behind the horns considerably inflated and showing the remains of the two anterior terga and sterna, then narrowing gradually with a thickening and increasing chitinization of the skin, and forming a narrow stalk just in front of the trunk, where it is bent ventrally at a right angle. Trunk thickening rapidly beyond the bend, cylindrical, the same diameter throughout and abruptly truncated at the posterior end. Abdomen a small spherical knob on a level with the dorsal surface and inclined dorsally; neither specimen carried egg strings and so they are unknown.

First antennae short, slender, curved sharply backward, and very indistinctly segmented, if at all, rather well supplied with setae at the tips and along the outer margins. Second antennae large and stout and three-jointed, basal joint the narrowest, terminal joint strongly flattened and in the form of an equilateral triangle, whose apex is articulated with the second joint and whose base is distal, twice the width of the basal joint, and armed with a powerful chela, made up at the outer angle of a long sickle-shaped claw whose tip shuts down inside a stout process at the inner angle; this claw is operated by strong muscles which fill the interior of the joint. Proboscis cylindrical, of about the same diameter as the carapace and strongly protrusile (fig. 72). It is usually extended straight in front of the head, but can be moved about in various directions.

At the tip the upper lip divides into two lobes, which stand out prominently when the proboscis is retracted, but are folded over tightly against its side when it is extended. The underlip forms a single median lobe, which is also more prominent in the retracted proboscis.

Between these lobes extends the mouth tube, much as in *Lernaeenicus;* it is very short and less than half the diameter of the proboscis, and the opening is surrounded by a deeply fringed membrane. Beneath the center of the upper lip and dorsal to the esophagus lies a tripartite eye, which is very distinctly visible in the cleared specimen.

This eye is still farther out toward the tip of the proboscis than in *Lernaeenicus*, but otherwise its general relations are the same.

On the sides of the mouth tube are the second maxillae, three-jointed, the basal joint long and slender, the second joint three-fifths as long and carrying a small process on the inner margin, the terminal joint in the form of a curved claw, nearly as long as the second joint.

Just above the bases of these second maxillae there is on either side a tiny, one-jointed process, tipped with two minute setae, which represents the first maxilla. These can only be seen in an end view since they are in the bottom of the groove between the lips and the mouth tube, and are entirely concealed by the lobes in a side view.

The three pairs of legs are close together on the ventral surface of the thorax; the basal plates of the first two pairs are broadly triangular, those of the third pair are narrow oblong; the two former are biramose while the latter is uniramose, and the rami are each two-jointed and tipped with two or three long setae.

Internal specific characters of female.—Esophagus nearly in line with the head axis; stomach considerably enlarged, but not sending out processes laterally and not convoluted. Intestine narrowed through the neck, then enlarged in the anterior trunk, where it passes

at once to the dorsal portion below the ovaries and is strongly flattened dorso-ventrally between the ovaries and oviducts; rectum fairly long and inclined dorsally.

Ovaries two-third as long as the oviducts and not much flattened, but cylindrical and pointed at the posterior end; oviducts slightly flattened and in about the center of the trunk dorso-ventrally; cement glands relatively narrow, the lumen of the glandular portion scarcely wider than the duct, the two about the same length and both reduced to a mere line.

The chitinogen layer of this species would have been extremely satisfactory to Claus in his search for "subcutaner Drusen." It is thin and uniform along the midline dorsally and ventrally and for some distance on either side, especially between the ovaries and the dorsal surface. But along the sides of the body and more particularly around the anterior and posterior ends of the trunk it is greatly thickened, as shown in figure 78, and nearly every cell communicates with the exterior through a pore canal in the chitin layer. Along either side ventrally, where the chitinogen layer begins to thicken, there is a row of 12 large glands, whose central lumen opens through a pore.

These glands are seen in section in figure 78, and in surface view enlarged in figure 79. Each consists of five or more cells arranged radially around the central lumen, and in the cleared specimen they are dark cinnamon brown in color and so opaque as not to show their nuclei.

It is especially worthy of note that this chitinogen layer covers the enlarged portion of the neck and the soft horns of the cephalothorax, thus offering a sharp contrast with the genus *Laernaeenicus*, whose horns and neck are completely chitinized.

Color (preserved material), a brownish yellow, darker on the cephalothorax and trunk, lighter on the neck.

Total length, 22 mm. Length of cephalothorax, 1.35 mm.; width, 2 mm. Length of trunk, 9 mm.; width, 2 mm.

(*lobatus*, lobed, alluding to the upper and lower lips.)

Genus PHRIXOCEPHALUS Wilson.

Phrixocephalus WILSON, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 461.

External generic characters of female.—Cephalothorax a short cylinder, somewhat flattened and chitinized, sending out from one to three pairs of lateral cylindrical horns, more or less branched and chitinized, and a few frontal processes in the form of knobs or short horns. Neck cylindrical and hardened, with one or more sets of horns, simple or branched, the last set opposite the fourth legs; inserted in the trunk eccentrically, to one side of the midline, and some-

what twisted. Trunk abruptly enlarged and slightly twisted, at right angles with the neck; abdomen small and hemispherical, with a pair of rudimentary anal laminae destitute of setae; egg strings attached laterally and nearer the dorsal surface; tightly coiled into a spiral; eggs numerous and uniseriate.

Two pairs of minute antennae, second pair chelate; mouth parts reduced to mere chitin knobs; proboscis small and nonretractile. Four pairs of swimming legs, first two pairs close together, biramose, rami one-jointed, third and fourth pairs removed a considerable distance and uniramose, all the rami armed with setae.

Internal generic characters of female.—Bilateral symmetry distorted; esophagus inclined to the head axis and very short; stomach without lateral lobes or convolutions. Intestine very narrow through the neck, but much enlarged in the trunk; rectum short, given off from the dorsal, posterior corner of the intestine and somewhat inclined dorsally.

Ovaries on the dorsal surface, nearer the posterior end, diagonal to the trunk axis, and not much flattened; oviducts also diagonal to the trunk axis but in the opposite direction to the ovaries, the one on the side to which the neck is attached close to the ventral surface, the other considerably elevated above it, but the two pass down around the intestine on opposite sides. Cement glands both on the side of the elevated oviduct and not parallel to each other either laterally or vertically, but deviously curved, the glandular portion much longer than the ducts and indistinctly segmented. Chitinogen layer of the body wall most developed in the trunk, especially at the posterior end; no definite skin glands.

Genus habitat.—This genus fastens to the eye of its host, burrowing in from the outer surface and bringing the mouth in contact with the blood vessels at the back of the eye. The head and neck are completely chitinized and covered with a thick cyst, they show both torsion and flexion.

Type of the genus.—Phrixocephalus cincinnatus Wilson, monotypic.

(*Phrixocephalus*, φριξός, a bristling of the hair, and κεφαλή, the head.)

KEY TO THE SPECIES.

1. Head with three pairs of lateral horns; neck with two sets of horns, all branched; trunk narrow oblong (30 mm.)[1]____*cincinnatus* Wilson, 1908.

1. Head with one pair of lateral horns, profusely branched; neck with one set of simple horns; trunk broadly triangular (11 mm.)
triangulus, new species, p. 76.

1. Head unknown; neck with one set of tripartite horns and inserted in the side of the trunk; the latter semioval in outline; egg strings widely divergent (5 mm.)_____*diversus*, new species, p. 77.

[1] Average total length of species.

Remarks.—This genus was founded upon a single specimen, which could be examined only superficially for its external characters. The new material here presented has slightly modified some of the characters and has added many new ones. Especial attention is called to the asymmetry of the body, which is comparatively slight in this genus, but which forms an initial step leading up to the complete distortion exhibited in the new genus *Collipravus* (p. 78). The elevation of the vulvae toward the dorsal surface is also worthy of note; in the new species, *diversus*, they are practically on a level with the dorsal surface.

The discovery of the two pairs of antennae and the two additional pairs of legs is particularly gratifying, since it makes this genus completely analogous with the others in the family. It is also very pleasing to find that the internal anatomy fully corroborates the asymmetry of the exterior.

PHRIXOCEPHALUS TRIANGULUS, new species.

Plate 9, figs. 80–84; plate 10, fig. 85.

Host and record of specimens.—Three females with egg strings were obtained from the eyes of *Neopercis multifasciata* at Owari Bay, Japan, by the Bureau of Fisheries steamer *Albatross* in 1906. One of these was a perfect specimen and is made the type of the new species, with Cat. No. 47799, U.S.N.M. The others become paratypes, with Cat. No. 47808, U.S.N.M.

Specific characters of female.—Cephalothorax barrel-shaped, a little longer than wide, made up of the head and first two thorax segments fused, and separated from the third thorax segment by a distinct groove. Anterior end squarely truncated and giving off three frontal processes in the form of short, lobed, chitin horns; a pair of large lateral horns curve over dorsally and send off rows of long posterior branches, more or less anastomosed. Third segment separated from the fourth by a groove: fourth segment somewhat enlarged, especially on the ventral surface, and armed with two lateral and a ventral horn in the form of large chitin spines. Neck behind the fourth segment considerably narrowed, chitinized, and joined to the anterior end of the trunk at a right angle; in the two larger specimens it is at the extreme right anterior corner, in the smallest specimen, about half the size of the other two but with egg strings, the neck is on the midline of the dorsal surface, but a short distance behind the anterior end. The head and neck are also twisted through an arc of 90°, so that the ventral surface of the neck faces inward toward the midline of the trunk. The latter is triangular in side view, considerably flattened laterally, and thickest at the posterior end; dorsal surface flat and nearly straight, ventral surface strongly convex; abdomen a small hemisphere at the posterior end

on the dorsal surface and inclined dorsally; egg strings attached near the dorsal surface, large in diameter, and coiled into a wide spiral.

Antennae reduced to mere knobs on the dorsal surface of the head, comparatively wide in diameter but elevated very little. Mouth parts also reduced to rounded chitin knobs, one on the midline in front of the base of the median frontal process, and behind this two on either side of the midline. First two pairs of swimming legs toward the posterior end of the cephalothorax biramose, the rami very indistinctly jointed; third pair posterior to the center of the third segment, uniramose, the ramus also indistinctly jointed; fourth pair on the posterior margin of the fourth segment also uniramose, but with a single joint; all the rami are well armed with setae. The basal joints of the first two pairs of legs are close together on the midline, those of the third pair are a little farther apart, while those of the fourth pair are widely separated, one on either side of the ventral horn.

Color (preserved material) a uniform dark brown, almost black, the frontal processes and lateral horns lighter brown.

Total length, 11 mm. Head and neck, 5 mm. long; third thorax segment, 0.80 mm. in diameter. Trunk, 6 mm. long, 2 mm. wide, and 3 mm. thick at the posterior end. Egg strings, 3.50 mm. long, 1.35 mm. wide.

(*triangulus*, triangular, alluding to the outline of the trunk.)

Remarks.—In the type-specimen it is possible that the antennae may have been broken off, since these minute appendages, when chitinized, are extremely brittle, but no scars of such a break could be found.

One of the lateral horns was broken, leaving a short stump, but it is assumed that this horn corresponded to the one on the opposite side.

In both the other specimens the head and anterior neck were lacking.

PHRIXOCEPHALUS DIVERSUS, new species.

Plate 10, figs. 86 and 87.

Host and record of specimens.—A single female with egg strings was taken from the eye of *Callionymus virgis* Jordan, at a depth of 65 fathoms in Totomi Bay, off Hamamatsu, Japan, at station 3713, by the Bureau of Fisheries steamer *Albatross.*

This is made the type of the new species with Cat. No. 47809, U.S.N.M.

Specific characters of female.—Head, first, second, and third thorax segments missing; fourth segment present and armed with two pairs

of forked horns, one pair lateral and one ventral, and a pair of uniramose swimming legs between the bases of the ventral horns. Trunk triangular, the dorsal margin nearly straight, the ventral margin strongly convex, these two forming the sides of the triangle; posterior margin or base of the triangle also nearly stright. Neck attached a short distance behind the anterior end or apex of the triangle, on the dorsal surface and not on the median line. Neck also twisted at right angles to the trunk, as in the other species, so that the ventral surface faces the lateral surface of the trunk. Egg strings attached on a level with the dorsal surface and standing out on either side so that they almost form a straight line at right angles to the trunk axis. Each string is comparatively long and thick, and the coils of the spiral are separated a little from one another.

Color (preserved material), neck and trunk a brownish yellow, egg strings orange yellow.

Length of trunk, 3 mm.; greatest diameter, 2 mm. Length of egg coils, 3.50 mm.; diameter, 1 mm. Diameter of egg strings, 0.33 mm.

(*diversus*, divergent, alluding to the egg coils.)

Remarks.—Since there is but a single mutilated specimen, it seems at first sight presumptuous to establish a new species for it. But it presents so many striking differences as to leave no doubt of its being a new species, and supplements the characters of the genus in such a way as to demand recognition. In *cincinnatus* the fourth thorax segment carried two pairs of profusely branched horns, with the fourth legs entirely concealed between their bases so that they escaped notice. In *triangulus* there were but three horns in the form of simple spines, and the unpaired ventral horn stood between the widely separated fourth legs. Here in *diversus* there are again two pairs of horns, but the ventral pair are only forked once, and the fourth legs are close together between their bases and are only partially concealed.

Again, in *cincinnatus* and *triangulus* the neck is attached to the extreme anterior corner of the trunk; here it is removed a short distance from the anterior end on the dorsal surface and is still attached to one side of the midline. Finally the egg strings which are parallel in all the other genera and species in which they are coiled are here so widely separated as almost to form one straight line at right angles to the axis of the trunk.

COLLIPRAVUS, new genus.

External generic characters of female.—Cephalothorax oblong, nearly cylindrical, sending out laterally two pairs and ventrally one pair of cushion-like processes. Second, third, and fourth thorax segments distinctly separated, each with a pair of cushion-like lateral processes. Neck narrow and chitinized, bent just behind the fourth

segment and armed with small branched chitin horns. The neck is joined to the trunk on the dorsal surface of the latter and considerably away from the midline.

Trunk ellipsoidal, the anterior end bluntly rounded, the posterior end with lobed processes over the bases of the egg strings. Abdomen as long as the trunk, flattened dorso-ventrally, and bent sidewise at right angles to the trunk axis. Egg strings coiled in tight spirals, eggs uniseriate.

Two pairs of antennae, second pair chelate; one pair of maxillae; four pairs of swimming legs, first two pairs close together and biramose, third and fourth pairs separated a short distance and uniramose, all the rami two-jointed.

Internal generic characters of female.—Bilateral symmetry completely distorted; esophagus inclined to the head axis, with a tripartite eye buried in the tissues at its base; stomach not sending out lateral lobes nor convoluted; intestine looped once in the trunk; rectum short and straight; an anal lamina, destitute of setae on either side of the anus.

Ovaries at the extreme posterior end of the trunk on the dorsal surface, each a flattened sphere inclined to the trunk axis; oviducts separated by the neck, then coming together again, running forward diagonally to the anterior end of the trunk, then backward on the ventral surface to the vulvae. Cement glands also separated by the neck, then closing together again; they start between the ovaries at the posterior end and run diagonally forward the whole length of the dorsal surface, then backward on the opposite diagonal on the ventral surface, with no differentiation between the glandular portion and the ducts.

Chitinogen layer of the body wall thickest in the posterior lobes of the trunk and in the abdomen, elsewhere very thin.

Genus habitat.—This genus, like *Haemobaphes*, burrows from the bases of the gill arches into the throat and buries its head and the four anterior thorax segments in the bulbus arteriosus of its host. The abdomen is bent outward, away from the fish's throat, on whichever side the parasite may be attached, and the egg strings project through the gill opening.

Type of the genus.—*Collipravus parvus*, new species, monotypic.

(*Collipravus*, *collum*, neck and *pravus*, irregular, misplaced.)

COLLIPRAVUS PARVUS, new species.

Plate 11, figs. 89–97.

Host and record of specimens.—Five females were obtained from the gill arches of *Jenkinsia stolifera* at Nassau, in the Bahamas, by the Bureau of Fisheries steamer *Albatross* in 1886. One of these is made the type of the new species with Cat. No. 47810, U.S.N.M.;

the others become paratypes with Cat. No. 12327, U.S.N.M. A single female, without a head, was obtained from the same host in the Florida Keys and was cleared in clove oil to obtain the internal anatomy.

Specific characters of female.—Specific characters the same as the generic, with the addition of the following details: Cephalothorax and anterior thorax segments all very soft and fleshy, the cushion processes much inflated, forming on the dorsal surface three longitudinal ridges, the central one the cephalothorax proper, the others the lateral processes.

On the fourth segment the lateral processes are conical and extend backward on either side of the neck. That portion of the neck which is inclosed in the bulbus arteriosus is also soft, but becomes gradually chitinous and where it passes out through the wall of the artery is armed with two or three branched chitin horns, which are buried in the adjacent tissue. The neck then softens again before it joins the trunk and is twisted somewhat upon its long axis, but just how much it was impossible to tell, because the two heads were packed so tightly together inside the bulbus arteriosus (see "*Remarks*" below). The anterior end of the trunk points forward toward the fish's mouth and the abdomen is turned outward away from the bulbus arteriosus, so that when there is a parasite on both sides of the fish the one is the reverse of the other.

The long egg coils reach out through the gill opening and are visible from the exterior when the operculum is closed; each, if uncoiled, would be at least three times the length of the trunk.

The first antennae are two-jointed and setiferous; the second pair are also two-jointed and comparatively minute; they project very little and the tooth of the chela is nearly as large as the claw. The maxillae are attached to the ventral surface of the head at the base of the mouth-tube, which can not be protruded very far, if at all; each maxilla is made up of two slender joints and a long needlelike claw, slightly curved. Only the first thorax joint is fused with the head, and this is fairly well differentiated on the sides by the lateral processes. The first and second swimming legs are close together, the second pair much larger than the first; the third and fourth pairs are separated by considerable intervals, each on the posterior margin of its segment. In the preserved material the basal lamina of every leg is heavily pigmented with black, which makes them stand out prominently.

Color (preserved material), head, neck, and trunk a light yellowish gray, egg strings orange yellow.

Length of trunk, 3.50 mm.; diameter, 1.50 mm. Length of head and neck, 2.50 mm. Length of egg coils, 4.50 mm.; diameter, 0.60 mm.

(*parvus*, small.)

Remarks.—In the material collected by the Bureau of Fisheries steamer *Albatross* there were three specimens which had been removed from their host and two which were still attached, one on either side, to the gills of a *Jenkinsia stolifera* 40 mm. long. As is usual in such cases the torsion in these parasites was in opposite directions, as was also the flexion of the abdomen. On dissecting out the parasites their necks were found to enter the ventral aorta of the host at about the same point, just in front of the two arteries that supply the posterior gill arch. Both necks turned backward inside the aorta and the heads of the parasites were found closely packed together and filling the entire cavity of the bulbus arteriosus.

One head (*a*) was superimposed upon the other (*b*), the dorsal surfaces of the two facing the ventral wall of the aorta and the ventral surface of (*a*) packed against the dorsal surface of (*b*). The head (*a*) was longer than (*b*), thus bringing its anterior ventral surface with the mouth-tube in front of the frontal margin of (*b*). Both mouths were thus unobstructed and could take in blood freely; the free anterior end of (*a*) was inflated into a cylinder the full size of the lumen of the bulbus, the remainder of (*a*) and the whole of (*b*) were much flattened dorso-ventrally.

This leads to the conclusion that under normal conditions, when there was but a single head inside the bulbus, its form would be cylindrical and but little flattened. Both heads have been used in the details here presented, and in the figures a dorsal and lateral view of (*a*) (figs. 90 and 91) and a dorsal and ventral view of (*b*) (figs. 92 and 93) are given.

How the tiny fish could live and apparently thrive with two such parasites literally sucking its heart's blood is a mystery.

The genus can be easily recognized by the flexion of the comparatively large abdomen and by the misplacement of the neck on the dorsal surface of the trunk. The complete distortion of bilateral symmetry in the internal morphology follows as a result of this misplacement.

LERNAEOCERINAE, new subfamily.

Subfamily characters of female.—Cephalothorax armed with hard chitin horns, more or less branched; neck and trunk curved, usually in the shape of the letter S; genital segment enlarged; no pregenital prominence but often lateral processes over the bases of the egg strings; the latter filiform, very long and coiled in loose masses or twisted into a tight and regular spiral; eggs uniseriate and packed like a row of coins.

Two pairs of antennae, second pair chelate; manibles unknown; no protrusible proboscis; two pairs of maxillae, second pair uncinate;

no maxillipeds; all the swimming legs close together and near the head.

Subfamily characters of Copepodid male (genus *Lernaeocera*).—Body like that of *Cyclops*, composed of a cephalothorax covered with a carapace; three free thorax segments, a fused fifth and genital segment, and a short, one-jointed abdomen; anal laminae small, each armed with 4 or 5 minute setae. Antennae and mouth parts as in the female, with the addition of a pair of well-developed uncinate maxillipeds; two pairs of biramose swimming legs, with two-jointed rami, third and fourth pairs uniramose, rami also two-jointed.

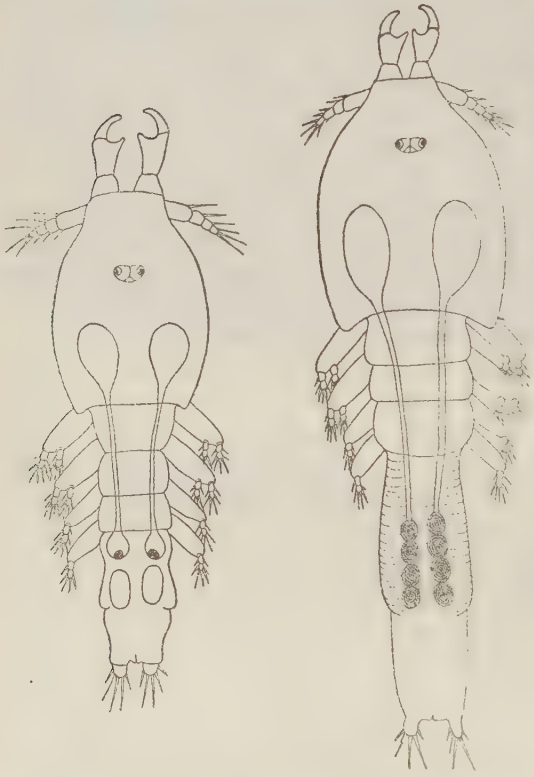

FIG. C.—THE MALE (LEFT) AND FEMALE (RIGHT) COPEPODID LARVAE OF LERNAEOCERA BRANCHIALIS, AFTER A. SCOTT: ACTUAL LENGTH OF FEMALE, 2.30 MM.

Ontogeny of genus Lernaeocera.—The genital protoplasm in the posterior end of the ovary forms egg mother cells and egg daughter cells, the latter filling the anterior end of the ovary without definite arrangement. These oocytes acquire food and yolk material as they pass into the oviduct, and are there strongly flattened and packed tightly in a single row. The cement glands are entirely separate from the oviduct and open into the latter just inside the vulvae. Each egg is surrounded by an external membrane of cement material as it passes out through the vulva into the external sack, where it is again flattened and arranged with the others like a row of coins. The larva hatches as a typical nauplius with the usual three pairs of appendages, and one pair of posterior balancers. The nauplius is transformed into a metanauplius while swimming about freely in the plankton. At the first copepodid stage it seeks out as a temporary host some fish other than the one which is afterwards to serve

the female for a permanent host. To this fish's gills it adheres by means of the chelate second antennae and proceeds to fasten itself to the apex of the gill filament by a broad frontal band of chitin. While thus attached it passes through two or three pupal stages during which there is the same disappearance of segmentation and of setae in the appendages as occurs in the Lernaeenicinae (see p. 43). But the reproductive organs develop, the body of the female elongates considerably, both sexes reach maturity, and fertilization takes place. The female, and sometimes also the male, then sever their connection with the gill filament and swim about again freely in the plankton.

The male soon dies, but the body of the female elongates still more and she then seeks out a final host and fastens to its gill arches with her chelate second antennae. She finally burrows through the intervening tissues to the immediate vicinity of the heart or the ventral aorta, where the head is securely anchored by the outgrowth of branched chitin horns. Here the female remains as a fixed parasite during the remainder of her life, which probably lasts a year or more.

Genus LERNAEOCERA Blainville.

Lernaea (part) Linnaeus, Systema Naturae, ed. 12, 1767, vol. 1, pt. 2, p. 1092.
Lerneocera Blainville, Journ. de Physique, vol. 95, 1822, p. 375.
Lernecocera (part) Nordmann, Mikrographische Beiträge, 1832, p. 130.
Lernaea Burmeister, Acta Acad. Caes. Leop. Nat. Cur., vol. 17, 1833, p. 319.
Lernaea (part) Milne Edwards, Histoire Naturelle des Crustacés, vol. 3, 1840, p. 528.
Lernaea, all subsequent authors.

External generic characters of female.—Cephalothorax globular, comparatively small, and furnished with three branched chitinous horns or anchor processes, the dorsal one usually a little longer than the lateral ones; second, third, and fourth thorax segments in the form of a slender neck of moderate length and of about the same diameter throughout; fifth and genital segments fused and more or less swollen, and with the abdomen bent into the form of the letter S; abdomen distinctly separated from the genital segment in immature stages, but completely fused in the mature adult; egg strings filiform, many times the length of the body, and coiled into irregular masses. First antennae three-jointed and well supplied with setae; second pair chelate and two-jointed; two pairs of maxillae, but no maxillipeds; first two pairs of swimming legs biramose, two posterior pairs uniramose, all the rami two-jointed.

Internal generic characters of female.—Mouth really terminal, but appearing lateral, owing to the inclination of the head; esophagus nearly in line with head axis; stomach without lateral processes or

convolutions, bent at right angles when it enters the neck and passing insensibly into the intestine, which is enlarged in the posterior neck and trunk; rectum very short and narrow. Ovaries fused on the midline of the dorsal surface, in the small of the back, and folded around the sharp curve in the body wall; oviducts passing around the intestine to the ventral surface and thence to the vulvae; cement glands ventral to the oviducts and plainly convoluted.

External generic characters of copepodid male.—Head and first thorax segment fused; second, third, and fourth thorax segments free; fifth and genital segments fused; abdomen one-jointed; anal laminae armed with short setae. Two pairs of antennae, second pair chelate; a pair of mandibles; two pairs of maxillae, second pair uncinate; a pair of stout maxillipeds.

Internal generic characters of Copepodid male.—Mouth tube at right angles to the head axis; stomach and intestine straight and indistinguishable; rectum very short: large digestive glands along either side of the cephalothorax. Testes paired and situated in the posterior portion of the cephalothorax; sperm ducts straight and dorsal to the intestine; spermatophore receptacles in the genital segment large and elliptical.

Type of the genus.—*Lernaeocera branchialis* (Linnaeus), first species.

(*Lernaeocera*, *Lernaea*, and κέρας, a horn).

KEY TO THE SPECIES.

1. Head without anchor processes, simple, and filiform; body not flexed; egg strings not coiled; no appendages (13.50 mm.)[1]
abyssicola (Brady), 1883, doubtful.
1. Head with simple unbranched processes; neck long and slender; body with a strong curve or simple flexure; egg strings sometimes regularly coiled 2
1. Head with branched processes; neck short and stout; body with double sigmoid flexure; egg strings always loosely coiled 3
2. Head small, subspherical; genital segment and abdomen covered with a dense filamentous growth; egg strings coiled in a regular spiral (20 mm.)
lotellae (Thompson), 1889.
2. Head small, funnel-shaped, joined to the neck at an acute angle; genital segment and abdomen covered with scattered tufts of setae (22.50 mm.)
rigida (Krøyer), 1863.
2. Head large and spherical; genital segment only slightly wider than the neck and separated from the abdomen by a constriction; no setae or filaments (50 mm.) ..... *lumpi* (T. Scott), 1901.
3. The posterior horn the only one developed, as long as the whole body, in line with it and profusely branched; egg strings in a few loose coils (15 mm.) ..... *branchialis*, var. (Hesse), 1891.
3. Genital segment with but a single curve; processes flat and short, but much branched; egg strings stout and their coils larger than the entire genital segment (8 mm.) ..... *minuta* (T. Scott), 1900.

[1] Average total length of species.

3. All three processes or horns developed; genital segment with a double sigmoid curve; egg cases coiled but slender 4
4. Horns slender and cylindrical, all about the same length; abdomen completely fused with genital segment (40 mm.)
branchialis (Linnaeus), 1767, p. 85.
4. Horns flattened and laminate, posterior one three times the length of the lateral ones; abdomen not recurved; coils of the egg strings very large (14 mm.) ..... *lusci* (Bassett-Smith), 1896.
4. Horns very short, bilobed but not branched; abdomen boot-shaped and strongly narrowed where it joins the genital segment (32 mm.)
godfroyi (Quidor), 1912.

LERNAEOCERA BRANCHIALIS (Linnaeus).

Plate 10, fig. 88; plate 12, figs. 98–107; plate 17, fig. 140.

Lernaea branchialis Linnaeus, Systema Naturae, 1767, vol. 1, pt. 2, p. 1092.—Claus, Gesellschaft zur Beförderung der gesammten Naturwissenschaften zu Marburg, vol. 9 supplement, 1868, p. 16, pls. 3, 4.—Metzger, Archiv für Naturgeschichte, vol. 34, 1868, p. 106.—A. Scott, Liverpool Marine Biology Committee Memoirs, No. 6, 1901, p. 33.—T. and A. Scott, British Parasitic Copepoda, Ray Society, London, 1913, p. 142, pls. 42, 43.

Lernaea gadina Fabricius, Fauna Groenlandica, 1780, p. 336.

Lernaeocera branchialis Blainville, Journ. de Physique, 1822, vol. 95, p. 376, 1 plate.

Lernaeocera branchialis Nordmann, Mikrographische Beiträge, 1832, heft 2, p. 130.

Host and record of specimens.—This parasite is very common upon various species of Gadidae, especially the common cod, as the following list of specimens in the National Museum collection will show. It is always found near the base of the gill arches with its head buried in the underlying tissues close to the heart or the ventral aorta.

From the Greenland cod, *Gadus ogac*, 2 females, Cat. No. 6211, from Disco Bay, Greenland. From the common cod, *Gadus callarias*, 1 female, Cat. No. 6145, from Georges Banks; 1 female, Cat. No. 8488, from Harpswell, Maine; 4 females, Cat. No. 12910, from Woods Hole, Massachusetts; 2 females, Cat. No. 12911, from Browns Banks; 2 females, Cat. No. 12912, from Casco Bay, Maine; 1 female, Cat. No. 14324, from Harpswell, Maine; 5 females, Cat. No. 42329, from Casco Bay, Maine; 1 female, Cat. No. 47811, from Harpswell, Maine; 3 females, Cat. No. 47812, from Woods Hole, Massachusetts; 3 females, Cat. No. 47813, from Woods Hole, Massachusetts; 2 females, Cat. No. 47814, from Harpswell, Maine; 3 females, Cat. No. 47815, no locality.

Cat. No. 42300 contains 2 females with no host given; it came from the Omaha Exposition.

External specific characters of female.—Cephalothorax globular and provided with three branched horns, two lateral and one median

and dorsal; horns chitinous and profusely divided, the tips of the subdivisions usually somewhat swollen. Neck about the same diameter throughout and often showing transverse wrinkles. Trunk considerably enlarged and elongated, the portion representing the genital segment of about the same diameter, the abdomen tapering to a bluntly rounded end. In the full-grown adult there is no groove or other indication of the point of junction of the genital segment and abdomen as there is in immature specimens, but the two are indistinguishably fused and are bent into the form of the letter S .

A pair of minute anal laminae can be easily detected in half-grown specimens, and they persist in the mature adult, each being tipped with a single seta. The egg strings are voluminous and each is drawn into a loose and irregular coil which, if straightened, would be several times the length of the entire body; eggs minute and strongly flattened.

Two pairs of antennae on the dorsal surface of the head as in all the Lernaeidae, the first pair three-jointed, with a tuft of setae at the tip, the second pair two-jointed, the joints about the same size, the terminal one bearing a stout chela. Proboscis strongly protrusible; when fully extended (fig. 101) it forms a bluntly rounded cone on the front of the head, pointed backward parallel with the axis of the neck, and carrying on its tip the two pairs of maxillae. In preserved specimens the proboscis is usually withdrawn so completely that it pulls in with it the whole front of the head and causes the latter to assume a cup shape, as represented in Emerton's excellent figures (figs. 98–100).

The muscles which control this proboscis are evidently arranged like those in *Peniculus* (fig. 2), so that the mouth tube proper can be withdrawn a long distance. At the tip of the mouth tube are the two pairs of maxillae, the first pair (*mx*, fig. 103) short finger-like papillae, divided at the tip and each portion armed with a single large seta. On the outer margin of the papilla near the base is a small, rounded palp-like protuberance. The second maxillae are two-jointed, the basal joint stout and armed at its distal end on the dorsal surface with the two claw-like processes noted by Claus as characteristic of the same appendages in the copepodid female. The terminal joint is also stout but smaller than the basal joint, and it ends in a stout claw.

Behind the cephalothorax come the four pairs of swimming legs, the first two pairs close together and biramose, the third and fourth pairs removed a very short distance and uniramose, all the rami two-jointed and well supplied with setae. Color, a dark brownish red, due to the contained blood; horns dark brown; head and egg strings a light orange yellow.

Total length, if the body were straightened, about 40 mm. Greatest diameter of trunk, 8 to 10 mm. Length of egg strings if straightened, 150 to 200 mm.

(*branchialis*, pertaining to the gills, which are its habitat.)

Internal specific characters of female.—Esophagus short and inclined at an angle of about 60° to the axis of the neck, entering the stomach at the anterior end with little or no sphincter muscle at the junction.

Stomach increased to about 2 diameters in the neck, passing insensibly into the intestine, which is abruptly enlarged in the genital segment.

The fused ovaries are produced into horn-like projections anteriorly and posteriorly, which are strongly flattened dorsoventrally and fit down on the dorsal surface of the intestine like a saddle, the flaps extending nearly to the center of the side of the intestine. Each anterior horn tapers to an apex which lies dorsal to the intestine and from which the oviduct leads around the outside of the intestine to the ventral surface and follows that surface back to the vulva. These oviducts are exceptionally narrow compared with the size of the parasite and along the ventral surface are wholly ventral to the intestine. Each cement gland is about the same diameter as the oviduct, along whose inner ventral surface it extends, the two glands being in contact with the ventral body wall and close to the midline. The anterior end of the gland turns up with the oviduct for a short distance on the outside of the intestine at the base of the neck and terminates in a blunt point. The chitinogen layer of the body wall is poorly developed.

Specific characters of the Copepodid male.—Cephalothorax elliptical, narrow anteriorly through the bases of the antennae, almost squarely truncated posteriorly, and covered with a dorsal carapace. Second, third, and fourth thorax segments about the same length and width, which latter is half that of the carapace. Line of demarkation between the fifth and genital segments indicated by lateral notches. Abdomen short, much narrower than the genital segment; anal laminae each armed with 4 or 5 setae. First antennae four-jointed, the basal joint much longer than any of the others, each joint well armed with setae; second antennae comparatively small, two-jointed, the joints about the same size and triangular, the terminal joints tipped with a stout chela. Proboscis long and fairly stout; mandible in the form of a long and slender spine; first maxilla a short papilla tipped with two long setae; second maxilla two-jointed, joints the same width but the basal one somewhat the longer, terminal claw short and stout; two-jointed maxillipeds present behind the maxillae, the terminal joint the same length as the basal but much narrower, terminal claw short and pointed.

Internally there is a large tripartite eye a little in front of the center of the cephalothorax. The testes are paired and at the extreme posterior margin of the cephalothorax; the sperm ducts open out of their posterior ends and run back to the genital segment where each is enlarged into a pair of receptacles within which are formed and stored the spermatophores.

Total length, 1.75 mm. Diameter of cephalothorax, 0.45 mm.

Nauplius.—General outline diamond-shaped, considerably flattened dorso-ventrally, a trifle longer than wide, all the corners well rounded, Three irregular patches of pigment on the dorsal surface, one at each of the lateral angles and the third at the posterior angle. The anterior angle is filled by the large compound eye, whose pigment is the same color as that of the dorsal patches, a yellowish purple. Behind the eye may be seen the first traces of the nerve ganglion, not as yet clearly developed. And behind the ganglion, occupying the bulk of the center of the body, is a single large oil globule similar to that noted in *Lernaeenicus longiventris* (p. 68). First antennae armed with a bunch of short spines on the dorsal surface near the distal end and the usual two long terminal plumose setae. Second antennae and mandibles of the typical pattern, biramose, the exopod four-jointed, each joint bearing a plumose seta, the endopod with a single joint tipped with two setae. Balancers slender and curved, turned at right angles to the body axis so that the two are in the same straight line.

Total length, 0.45 mm. Greatest width, 0.40 mm.

Metanauplius.—General outline an elongated oval, the pointed end posterior, the margin evenly rounded. The posterior pigment spot has increased in size while the lateral ones have fused across the mid-line. The eye is relatively smaller and not as close to the anterior margin. The appendages remain approximately as before except that the endopods of the second antennae and mandibles are now distinctly jointed, and the terminal joint of each is armed on the inner margin with a stout spine. At the posterior end of the body inside of the skin may be seen the beginnings of two free thorax segments, a fused fifth and genital segment, and a one-jointed abdomen with anal laminae. The balancers turn forward as before, but are now jointed close to their base, while the terminal portion is flattened dorso-ventrally and bluntly rounded at the tip. Between these from the posterior end of the body projects a short conical process, with a pair of blunt rounded spines on either side at its base.

This is the posterior body of the metanauplius, while that which is seen inside of the skin is to become the posterior body of the first copepodid larva after the next molt.

Total length, 0.55 mm. Greatest width, 0.25 mm.

Remarks.—The present is one of the longest known and most frequently mentioned species amongst the parasitic copepods. Every zoologist has become familiar at least with its name and some of its reputed characteristics. It has long served as one of the stock examples used to illustrate degeneration and retrogression, and the average opinion with reference to it has been well expressed by Dr. Andrew Wilson in an article on Degeneration in the Popular Science Monthly for June, 1881, in which he said "Beginning life as a three-legged 'nauplius,' the lernean retrogresses and degenerates to become a mere elongated worm, devoted to the production of eggs, and exhibiting but little advance on the sacculina" (p. 227).

The appendages have been variously reported as rudimentary or entirely obsolete, even up to the very latest publications with reference to them. At the time of the first discovery of the male by Metzger and Claus (1868), the latter called particular attention to the presence of a compound eye, of anal laminae, and of the various appendages in the adult female, but the significance of his discoveries were overlooked and soon forgotten. As far as the appendages are concerned, the present species shows neither retrogression nor degeneration. The adult female retains all the appendages that she ever possessed, and they are as fully developed in the adult as they were in the copepodid stage. The only change that has been made is that the parasite has ceased to use some of them, and they have consequently become brittle and are easily broken off. And even if we apply to them the term rudimentary, we must remember that they are no more imperfectly developed in the adult than they were in the larva. In the body form there is an elimination of joints, more or less fusion of various body regions, and considerable distortion, so that here we do find retrogression. In the future, therefore, in dealing with this species we should remember that the appendages can not be classed with the body form, but that the two are distinctly separate.

Genus LERNAEOLOPHUS Heller.

Pennella (part) NORDMANN, Galerie du Muséum d'Hist. Nat. de Paris, 1839; *P. sultana*, afterward made the type of Heller's genus; Bull. de la Soc. Imp. des Nat. Moscou, 1864, vol. 37, p. 485, *P. sultana*, var. *sigmoida*.

Penellus (part) MILNE EDWARDS, Histoire Naturelle des Crustacés, vol. 3, 1840, *P. sultana*, p. 523.

Lernaea (part) KRØYER, Naturhistorisk Tidsskrift, 3 Raekke, 2 Bind, 1863, *L. hemiramphi*, p. 318, afterwards transferred to Heller's genus.

Lernacolophus HELLER, Reise der *Novara*, 1865, p. 251, *L. sultanus*, monotypic.

Lernacolophus WILSON, Proc. U. S. Nat. Mus., vol. 44, 1913, *L. recurvus*, p. 252, pl. 46; *L. striatus*, p. 254, pl. 47, figs. 260, 261.

External generic characters of female.—Cephalothorax inclined ventrally to the neck axis; a pair of lateral and an unpaired dorsal

horn, chitinous; neck cylindrical, heavily chitinized, and showing considerable torsion, attached to the trunk on the midline. Trunk bent in a sigmoid curve, also heavily chitinized; abdomen large, with rudimentary anal laminae, armed with a double row of dichotomously branched processes; egg strings coiled in a loose mass like those of *Lernaea* and concealed by the processes.

Two pairs of antennae, second pair chelate; proboscis somewhat protractile; mouth parts replaced by small knobs; first two pairs of swimming legs biramose, third and fourth pairs uniramose, all the rami two-jointed and setiferous; the four pairs close together behind the head.

Internal generic characters of female.—Bilateral symmetry complete; stomach without lobes; intestine wide and much convoluted in the neck, greatly enlarged in the trunk, then narrowed in the abdomen; rectum short; ovaries extending from the bend some distance forward into the neck, nearly as long as the oviducts, strongly flattened posteriorly, but nearly cylindrical anteriorly; oviducts very wide, somewhat flattened laterally, and at the sides of the intestine rather than ventral to it; in fact the ovary and oviduct almost come together and completely cover the lateral surface of the intestine. Cement glands between and ventral to the oviducts, glandular portion much longer than the duct, curved dorsally at the interior end around the outside of the oviduct, or sometimes passing up inside of the oviduct and curving over the top and down on the outside; duct of cement gland convoluted. Chitin layer of body wall much thickened and very hard; chitinogen layer thickest along the sides of the body and in the abdomen; no definite skin-glands.

Genus habitat.—This genus burrows into the underlying tissues from various places in the mouth and throat of their fish host, on the jaw, the roof of the mouth, gill arches, etc. The entire body is strongly chitinized and shows both torsion and flexion.

Type of the genus.—*Lernaeolophus sultanus* (Nordmann), monotypic.

(*Lernaeolophus*, *Lernaea* and λόφος, a crest or tuft.)

KEY TO THE SPECIES.

1. Body straight or only slightly curved; a distinct groove at the base of the neck; abdominal processes 20 or more on either side and unbranched; (27 mm.)[1] ..... *striatus* Wilson, 1912.
1. Body folded back upon itself once at the base of the neck; abdominal processes 10 or more on either side, very slender and profusely branched; (20 mm.) ..... *recurvus* Wilson, 1912.
1. Body with a regular sigmoid curve 2
2. Abdominal processes 20 or more on either side, divided into numerous fine hairs at the tips (16 mm.) ..... *hemiramphi* (Krøyer), 1863.
2. Abdominal processes 10 or more on either side, dichotomously branched from the very base (15 mm.) ..... *sultanus* (Nordmann), 1864, p. 91.

[1] Average total length of species.

LERNAEOLOPHUS SULTANUS (Nordmann).

Plate 13, figs. 108–113.

Pennella sultana Nordmann, Bull. Soc. Impériale des Naturalists de Moscou, 1864, vol. 37, p. 485, pl. 5, figs. 12–16.

Penellus sultana Milne Edwards, Histoire Naturelle des Crustacés, vol. 3, 1840, p. 523.

Lernaeolophus sultanus Heller, Reise der *Novara*, 1865, p. 251, pl. 25, fig. 7.—Brian, Copepodi parassiti dei pesci d'Italia, 1906, p. 91.

Host and record of specimens.—Two females were obtained from the gill arches of the orange file fish, *Alutera schoepfii*, in Vineyard Sound in 1874, and have received Cat. No. 6186, U.S.N.M. Two other females were found by the present author in the upper jaw on the inside of the mouth of the garfish, *Tylosurus marinus*, at Woods Hole, Massachusetts, in August, 1903, and have received Cat. No. 47816, U.S.N.M. A single broken specimen was obtained from *Haemulon plumieri* by Dr. Edwin Linton at the Carnegie Institution, Tortugas, Florida, in July, 1908, and has received Cat. No. 47817, U.S.N.M.

Specific characters of female.—Cephalothorax spherical, at right angles to the neck axis, and covered with a hard chitin skin, divided by a shallow median groove on the anterior and ventral surfaces into two cushion-like halves or pads, each of which is prolonged on the ventral surface into a series of three short, rounded, and often lobed processes, which project from the pad-like fingers. These processes are covered with a thin chitin skin and their lumen is in connection with the cavity of the head. Posteriorly are given off a pair of lateral horns and an unpaired dorsal one, all three cylindrical, composed of hard chitin, and more or less branched.

These horns are also hollow to their very tips and, like the processes their lumen opens into the cavity of the head. Behind the horns the neck narrows a little, but remains comparatively wide and of about uniform diameter down to the trunk; its walls are very thick and hard.

The head and neck show a torsion of from 135° to 180°, bringing the ventral surface almost, if not quite, over the dorsal surface of the trunk. The latter enlarges gradually from the base of the neck and with the neck and abdomen is bent into a vertical sigmoid curve. The concave bend on the back of the trunk is narrow and sharp and is strengthened by a thick chitin ridge which runs across it, transverse to the trunk axis, and flattens out and disappears on either side. The convex ventral margin sweeps in a broad curve from the base of the neck to the vulvae. The abdomen is on a level with the dorsal surface, is fully two-thirds as long as the trunk, and is more than half as wide and deep. Along either side of the abdomen and

extending onto the posterior end of the genital segment are two rows of dichotomously branched processes. The upper row of six processes is a little below the dorsal surface of the abdomen and is still further depressed on the trunk. The lower row of five processes is parallel to the upper one, the last process standing on the median line of the genital segment (vertical median).

The branching of these processes varies considerably in different individuals, and probably in the same individual at different stages of development; the older the individual the more profuse the branching, the younger the individual the simpler the processes. As might be expected these branched processes furnish excellent anchorage for various fixed forms of animal and plant life, and they are often found covered with algae or protozoa. The processes in the two rows alternate with one another, and the tip of the abdomen is left free. This tip is slightly bilobed and on either lobe, close to the anus, is a rudimentary anal lamina, destitute of setae. The egg strings are curled into a loose and irregular coil, as described by Kroyer and Nordmann, and are not in a regular convolute spiral as stated by Heller.

The first antennae are minute, two-jointed and tipped with setae; the second pair are also two-jointed and tipped with a strong chela, the nearly straight claw shutting down behind a catch on the opposite margin of the terminal joint. Proboscis in the bottom of a groove on the ventral surface of the head, of softer tissue than the surrounding parts, and apparently capable of being somewhat protruded; mouth parts lacking.

Four pairs of swimming legs close together in the curve of the neck just behind the head. The basal joints of these legs are rounded oblong, the first two pairs with a basal projection on the inner margin. The rami are usually broken off, but occasionally a leg will be found with the rami intact, when we can see that the first two pairs are biramose, the third and fourth pairs uniramose, the rami all two-jointed and well armed with setae.

Color (preserved material), the uniform reddish brown characteristic of chitin in alcohol.

Total length, including the sigmoid curvature, 15 mm. Cephalothorax, 1.50 mm. long, 1.50 mm. wide. Neck, 1 mm. in diameter. Genital segment, 2.50 mm. in diameter.

(*sultanus*, like a sultana).

Remarks.—The discovery of the two pairs of antennae on these specimens necessitates a different interpretation of the knobs found on the ventral surface of the head.[1]

[1] See Proc. U. S. Nat. Mus., vol. 44, p. 252–255.

These can no longer be regarded as rudiments of the antennae and mouth parts for several reasons:

1. The true antennae have been found in their proper position on the dorsal surface of the head. In creatures as thoroughly chitinized as this genus of parasites the minute appendages break off with especial ease, and the present author has never before seen specimens to which they remained attached. And when once broken off it is practically impossible to find any scars showing their former presence.

2. On comparing different specimens of *sultanus* the form and size of these knobs is found to vary far more than would be probable if they were the rudiments of appendages.

3. The interior of the knobs is in connection with the cavity of the head, which is manifestly unlike the condition of appendages.

They must be regarded, therefore, as mere processes, corresponding to the frontal processes in other genera, but in this genus restricted in number and confined to the ventral surface. In this genus then, as in *Pennella*, the maxillae have apparently disappeared.

The distinctive characters in the morphology of the species are the chitinization of the entire body so that its form remains the same however poorly it may be preserved, the two rows of branched processes on the sides of the abdomen and genital segment, the pushing of the ovaries and oviducts forward into the base of the neck, and the convolution of the ducts of the cement gland.

Genus HAEMOBAPHES Steenstrup and Lütken.

Haemobaphes Steenstrup and Lütken, Kongelige Danske Videnskabernes Selskabs Skrifter, 5te Raekke, 1861, p. 405.

External generic characters of female.—Cephalothorax subspherical, much inflated and soft, with a tripartite eye buried in the tissues over the base of the esophagus; produced laterally into a cushionlike process on either side, with a short, rounded point extending diagonally forward and outward; anterior margin with a rounded knob on either side of the midline.

Second, third, and fourth thorax segments distinctly separated, the first two nearly as wide as the cephalothorax and sometimes produced laterally into cushionlike processes, the fourth segment narrower with short, bilobed processes on the venterolateral surface like those in *Chondracanthus;* similar processes sometimes found on the third segment.

Neck long, slender, cylindrical, and flexed upon itself a little in front of the center, where it is completely chitinized and armed with numerous short chitin horns, simple or branched.

Trunk much swollen, bent into a sigmoid curve, the ventral surface on the convex side, with a pair of short, swollen processes over the bases of the egg strings; abdomen relatively large, swollen, and cylindrical, with a pair of lateral processes near its base; egg strings long, each coiled in a tight spiral; eggs uniseriate and closely packed.

Two pairs of antennae, second pair uncinate; proboscis short, conical and nonretractile; first maxillae apparently lacking, second pair uncinate; four pairs of swimming legs, first two pairs biramose, rami two-jointed and setiferous; third and fourth pairs uniramose, rami one-jointed and setiferous.

Internal generic characters of female.—Bilateral symmetry completely preserved; intestine narrowed through the neck, moderately enlarged in the genital segment, and occupying the entire lumen of the abdomen; rectum long and conical; ovaries on the dorsal surface just in front of the concave flexure, their anterior third more or less cylindrical, their posterior two-thirds much flattened and spread out laterally over the dorsal surface of the intestine; oviducts on the ventral surface of the intestine and narrow; processes over the bases of the egg strings filled with muscles which probably give the latter their coiled form; glandular portion of the cement glands longer than the ducts, both glands and ducts parallel but removed a little distance from the midline; chitinogen layer of body wall well developed along the sides of the trunk and in the two pairs of lateral processes at the posterior end.

Genus habitat.—This genus inserts its soft head and anterior neck into the ventral aorta or bulbus arteriosus of its host, burrowing in from the gill arches. The neck is flexed sharply where it enters the aorta, and usually turned to one side, but there is no torsion.

Type of the genus.—*Haemobaphes cyclopterina* (Fabricius), monotypic.

(*Haemobaphes*, αἷμα blood, and βαφή dipped or dyed).

KEY TO THE SPECIES.

1. A series of lobed but unbranched processes on either side of the head and four anterior thorax segments; trunk with sigmoid flexure and lateral processes (34 mm.)[1]_____*cyclopterina* (Fabricius), 1780, p. 95.
1. A series of profusely branched processes on either side of the head and four anterior thorax segments; trunk nearly straight and without lateral processes (16 mm.)_____*enodis*, new species, p. 97.
1. A single pair of bilobed processes on either side of the cephalothorax, none on the free thorax; trunk with sigmoid flexure and lateral processes (20 mm.)_____*dicraus*, new species, p. 98.

[1] Average total length of species.

HAEMOBAPHES CYCLOPTERINA (Fabricius).

Plate 14, figs. 114–118.

Lernaea cyclopterina Fabricius, Fauna Groenlandica, 1780, p. 337.—Krøyer, Naturhistorisk Tiddskrift, 1837, p. 502, pl. 5, fig. 4, *a—e*.—Baird, Proc. Zool. Soc. London, 1861, p. 239.

Schisturus cyclopterinus Oken, Lehrbuch Naturgeschichte, 1816, p. 183.

Lerneocera cyclopterina Blainville, Jour. de Physique, vol. 95, 1822, p. 376.

Haemobaphes cyclopterina Steenstrup and Lütken (given under genus above).—T. and A. Scott, British Parasitic Copepoda, Ray Society, 1913, p. 147, pl. 44, figs. 5–7.—Wilson, Contrib. Canadian Biology, 1906–1910 (pub. 1912), p. 99.

Host and record of specimens.—Fifteen females with egg strings were obtained from the gills of *Cyclogaster ingens* Gilbert, in the Sea of Japan off the Korean coast at station 4863 of the fisheries steamer *Albatross* in July, 1906, and have been given Cat. No. 47818, U.S.N.M. Three single females were obtained from the gills of *Lycenchelys* (*Lycodes*) *verrillii*, the first two by the steamer *Speedwell* in the Gulf of Maine in August, 1877, the third "near La Have" in 1888. These have been given, respectively, Cat. Nos. 6137, 38331, and 47819, U.S.N.M.

Specific characters of female.—The specific characters are the same as the generic characters already given, but to them we may add the following details.

The entire cephalothorax and that portion of the neck in front of the flexure was very soft and easily lacerated, which contrasted strongly with the firm and solid condition of the remainder of the body. This is the portion which hangs free within the fish's aorta and doubtless remains soft for that reason. On the dorsal surface the cephalothorax proper is distinctly indicated by a central longitudinal ridge, which narrows anteriorly over the mouth parts, but there are no visible traces of a carapace.

On either side is a long cushion-like process, which narrows into a small knob anteriorly and curls downward and inward over the ventral surface almost to the median line. Dorsally these processes are on a level with the central cephalothoracic ridge, ventrally they project considerably. In front of them two other cushion processes are given off from the ventrolateral surface, which also project ventrally.

Between the rounded anterior ends of these processes are found on the anterior margin the two pairs of antennae and on the ventral surface the mouth parts. The cephalothorax is separated from the second thorax segment by a distinct groove, and the second, third, and fourth thorax segments are similarly defined dorsally but are less distinct ventrally. The second and third segments are nearly as wide as the head, including the lateral processes; the fourth seg-

ment is abruptly narrowed to less than half that width. The second and third segments each have a pair of lateral cushion processes, as wide as the segment itself and smoothly rounded, those of the third segment having on the posterior ventral surface a small knob. The fourth segment sends out on either side a soft bilobed process, the lobes thick and bluntly rounded, and inclined a little ventrally.

Behind these lobes the neck narrows and becomes rapidly chitinized until it reaches the flexure, beyond which it is slightly enlarged and armed with chitin horns of varying numbers and patterns, but usually short and somewhat flattened. Behind these horns the neck is again narrowed until it reaches the trunk, which it enters exactly on the median line so that there is no distortion of the bilateral symmetry.

The antennae and mouth parts are at the extreme anterior end of the cephalothorax; the first antennae are stout, three-jointed, and well armed with setae; the second pair are made up of two stout joints, furnished with strong muscles and tipped with a chela, whose long and rather slender claw shuts down past a projection on the opposite margin of the terminal joint. The mouth tube is short and but little, if at all, retractile, with a well-defined ventral plate; no first maxillae could be detected; the second pair are three-jointed, the basal joint the shortest, the second joint the longest and stoutest and armed on its outer margin with a short spine; the third joint is tipped with a short and weakly curved claw. Only the two pairs of legs described by Steenstrup and Lütken could be detected; each of these is biramose and the rami are two-jointed and setiferous. With the three anterior joints of the free thorax so well differentiated we should look for four pairs of legs instead of two, and a perfect specimen will probably reveal them. (See *Remarks*, below.)

Color (preserved material) of the body, the soft portion of the neck, and the head grayish yellow, chitinous portions of the neck and egg strings darker orange yellow.

Total length, including curves, 34 mm. Cephalothorax and neck, 14 mm. long, 0.75 mm. in diameter. Greatest diameter of trunk, 4 mm. Egg coil, 14 mm. long, 2 mm. in diameter. Each egg string, if straightened, would be approximately 125 mm. long.

(*cyclopterina*, from the genus of fish on which it was first found.)

Remarks.—Fortunately the specimen numbered 38331 included a mutilated head; the neck had been broken at the flexure and the anterior portion was again broken between the cephalothorax and the second segment. But the broken parts could be placed together while they were being drawn, and it was much easier to orient them when thus separated from the trunk than it would have been when attached to it. The antennae and mouth parts were uninjured, but one leg of

each pair was gone and the remainder of the ventral surface was more or less lacerated, so that if the parasite originally possessed four pairs of legs the two posterior pairs might easily have been destroyed. The discovery of the antennae and mouth parts brings this species, and through it the genus up to a better analogy with the rest of the family. Steenstrup and Lütken, the founders of the genus, examined several specimens which they reported as perfect, but the best they could say of the cephalothorax was that it presented considerable likeness to that of *Pennella*. They found neither antennae, proboscis, nor mouth parts, and as far as is known no investigator since their day has even seen the parasite's head.

The internal morphology is peculiarly interesting since it shows that, in spite of the sigmoid curvature of the body, there has been no disturbance in the bilateral symmetry. In this particular it presents an important contrast to *Phrixocephalus* and *Collipravus*, in both of which there is more or less distortion.

HAEMOBAPHES ENODIS, new species.

Plate 20, figs. 156 and 157.

Host and record of specimens.—A single perfect female with egg strings was obtained from the gills of *Lycodapus fierasfer*, a small deep-sea fish, 4 inches in length, by the Bureau of Fisheries steamer *Albatross* 11 miles off Point Pinos Lighthouse, on the California coast, May 26, 1904. It is made the type of the new species, with Cat. No. 49702, U.S.N.M. Like all other species of this genus the head and anterior thorax are buried inside the bulbus arteriosus of the host, and there is but a single specimen on each fish.

Specific characters of female.—Cephalothorax and the three anterior free thorax segments about the same width, all four covered with numerous profusely branched cauliflower processes, which do not show any definite arrangement; these give this part of the body a peculiarly rough and swollen appearance; the head, the thorax, and these processes are exceedingly soft and fragile. Neck quickly becoming chitinous and armed with a single pair of short horns in front of the flexure; the portion behind the flexure enlarged in diameter and shorter than the portion in front of the flexure. Trunk almost straight with only a hint of the sigmoid curve; genital segment enlarged to four times the diameter of the neck, the dorsal margin only slightly concave, the ventral margin broadly convex, with no knobs or processes. Abdomen in line with the genital segment, about half the length and width of the latter, the same diameter throughout, and also without knobs or processes. Egg strings loosely coiled, the coils a little wider than the abdomen and about the length of the genital segment.

First and second antennae in the same position and similar in structure to those of *cyclopterina;* maxillae and proboscis also similar in position and structure; swimming legs entirely concealed by the cauliflower processes so that it would be necessary to remove the latter in order to ascertain their exact number and arrangement.

Color (preserved material), a uniform brownish yellow except the head and anterior thorax and their processes which are white.

Total length, 16.50 mm. Head and anterior thorax, 2 mm. long, 1.50 mm. wide.

Genital segment, 6 mm. long, 2.33 mm. wide. Egg coils, 6 mm. long, 1.50 mm. wide.

(*enodis*, destitute of knobs or processes.)

Remarks.—This species is so radically different from the others in the genus that it can be readily recognized by its general form without the details of the appendages. The absence of all knobs and processes on the trunk, the almost complete suppression of the sigmoid curve, and the profusion of cauliflower processes on the head and anterior thorax are the distinguishing characters. The size is also more in accord with the miniature host on which it lives.

HAEMOBAPHES DICERAUS, new species.

Plates 19 and 20, figs. 148 to 155.

Host and record of specimens.—Two females with egg strings were taken from the gill arches of *Chaeturichthys sciistius* at Hakodate, Japan. The more perfect of the two is made the type of the new species, with Cat. No. 49703, U.S.N.M. The other becomes a paratype, with Cat. No. 49735, U.S.N.M. They were taken from separate fish, and each was fastened in the fish's throat at the base of the gill arches and had bored through the intervening tissues and buried its head inside the bulbus arteriosus.

Specific characters of female.—Head and all of the thorax inclosed within the bulbus arteriosus very soft and easily torn or crushed; cephalothorax with a single pair of lateral cushion processes, each of which is bifid; the anterior branch is on a level with the dorsal surface of the head, is short, cylindrical, bluntly rounded at the tip, and pointed directly forward parallel with the axis of the head; the posterior branch is enlarged into a circular cushion, evenly rounded and slightly flattened dorso-ventrally, and extends diagonally downward and backward to the ventral surface.

The second, third, and fourth thorax segments are distinctly differentiated; the second and third segments the same width as the head without the lateral horns, the fourth segment a little narrower; all three segments perfectly smooth, without knobs or processes. Neck a little more than half the width of the fourth segment, becoming rapidly chitinized, and armed with a single pair of short

spinelike horns just in front of the flexure. Beyond the flexure it enlarges gradually until it joins the trunk on the ventral surface and at the median line.

There is a large spherical swelling on either side of the genital segment at the anterior end, which starts on the dorsal surface and reaches almost to the ventral surface. It may even be said that it does reach that surface since its contour is indicated by a slight notch on the ventral margin. There are two small knobs on the ventral surface just in front of the egg coils, and a pair of lateral fleshy flaps or processes over the bases of the egg strings, which are elongated dorso-ventrally.

The genital segment passes insensibly into the abdomen, which is short, nearly straight, and twisted on its axis, so that the anal sinus shows in a side view of the trunk. Over the base of the abdomen two large processes are fused across the dorsal midline like a large saddle.

The egg coils are a little longer than the abdomen and taper toward their tips. The first antennae are three-jointed and well armed with setae; the second antennae are stout and two-jointed, the terminal joint a little narrower than the basal and armed at the tip on the outer margin with a stout curved claw, which shuts down inside a raised semicircle on the opposite inner margin.

Proboscis well developed and projecting from the ventral surface of the head; upper lip split lengthwise through the center, each half considerably wider than the mouth tube; the latter divided and grooved on the ventral surface and a little flattened on the dorsal surface; maxillae three-jointed, with a short and bluntly-pointed terminal claw.

Four pairs of swimming legs, the first and second pairs close together and a short distance behind the mouth, each biramose, the rami one-jointed, the endopod considerably smaller than the exopod, both well armed with plumose setae. The third and fourth pairs are on the posterior margins of their respective thorax segments; each is uniramose, the ramus one-jointed and armed, the third pair with five, and the fourth pair with four, large plumose setae. The relative distances of the three posterior pairs behind the first pair are represented by the numbers 1, 6, and 11.

Color (preserved material), a uniform orange yellow, the egg strings brown, the head and anterior thorax white.

Total length, if straightened, 20 mm.; from the flexure in the neck to the tip of the abdomen, 11 mm. Diameter of head through lateral processes, 1.25 mm. Diameter of genital segment, 4 mm. Diameter of abdomen behind the saddle, 2 mm. Length of egg coils, 6 mm.; diameter, 1.50 mm.

(*diceraus*, δις, two and κέρας, horn.)

Remarks.—This species is considerably smaller than *cyclopterina*, and may be recognized at once by the single pair of bifid processes on the cephalothorax, while the second, third, and fourth thorax segments are destitute of processes. This distinction may then be substantiated by the differences in the appendages, especially the maxillae and the swimming legs.

The head of this species was much better preserved than those of *cyclopterina*, and the details of all the appendages are distinctly shown. The long plumose setae upon the swimming legs are especially worthy of notice. Being buried inside the bulbus arteriosus of the host they have no chance to get broken or injured, and thus are preserved intact, as they were when the copepodid female first found her host.

The fact that the only head amongst the 15 females belonging to the species *cyclopterina* was mutilated, while in the single specimen of the species *enodis* both the cephalothorax and the free thorax were so covered with cauliflower processes as to effectively hide the swimming legs, makes it advisable to take the present species as our standard in the matter of the number and arrangement of the swimming legs.

Accordingly the genus diagnosis given above (p. 94) assigns four pairs of swimming legs to the genus, and there is every reason to believe that this will prove to be the correct number when more specimens of the other two species are obtained.

Genus HAEMOBAPHOIDES T. and A. Scott.

Haemobaphoides T. and A. Scott, British Parasitic Copepoda, Ray Society, 1913, p. 148, pl. 44, fig. 8.

External generic characters of female.—Cephalothorax subspherical and furnished with terminal branched chitin horns similar to those found in *Lernaea;* second, third, and fourth thorax segments not differentiated, but fused into a short neck, which is straight and not reflexed, and which carries neither horns nor processes. Trunk much swollen, bent into a sigmoid curve, with a pair of simple processes over the bases of the egg strings; abdomen longer than the genital segment, covered with irregular processes along the sides and on the dorsal surface at the base, and considerably enlarged at the tip. Egg strings coiled into a tight spiral which tapers toward the distal end. No details with reference to any of the appendages nor to the internal anatomy.

Genus habitat.—This genus bores into the gill arches of fish and anchors itself in the surrounding tissues by means of its chitin horns. It does not bury its head in the aorta or the bulbus arteriosus like the preceding genus.

Type of the genus.—Haemobaphoides ambiguus (T. Scott), monotypic.

(*Haemobaphoides, Haemobaphes* and the ending εἶδος denoting likeness).

Remarks.—T. and A. Scott established this new genus in 1913 for the species which T. Scott had described in 1900 as *Haemobaphes ambiguus*. It certainly seems to be a distinct genus, but it is unfortunate that neither in the original description nor in the new genus diagnosis are any of the appendages even mentioned. The internal anatomy is probably very similar to that of *Haemobaphes* and this makes the lack of external detail all the more regrettable.

TRIFUR, new genus.

External generic characters of female.—Cephalothorax enlarged nearly at right angles to the neck, and armed with a dorsal posterior median horn and two shorter conical lateral horns. Neck moderately thick, completely chitinized, and three times the length of the trunk, curved but not flexed, and smooth. Trunk only slightly swollen, bent into a sigmoid curve at right angles to the curve of the neck, the ventral surface on the convex side, with a pair of short and wide fleshy processes over the bases of the egg strings. Abdomen slender, half as long as the genital segment, and continuing the S-curve, destitute of processes; egg strips coiled into tight spirals, which are one-half longer than the abdomen; eggs uniseriate and flattened into thin disks.

Two pairs of antennae, second pair chelate; four pairs of swimming legs, two pairs close together just above the base of the cephalothorax, the others removed to some distance on the neck itself.

Internal generic characters of female.—Digestive tube occupying the center of the neck, the dorsal portion of the genital segment, and the center of the abdomen, abruptly contracted into a short rectum. Ovaries paired on the dorsal surface of the digestive tube at the anterior end of the trunk; oviducts running forward a long distance into the neck on the dorsal surface, then curved around the outside of the intestine to the ventral surface, following the ventral curve of the genital segment for half its length, then rising gradually to the center of the lateral surface.

Cement glands on the lateral surface of the genital segment at its anterior end and dorsal to the egg strings, running this way for half the length of the segment, then curving around outside of the egg strings to the ventral surface of the latter and following that surface back to the vulvae. The transition from gland to duct occurs just where it curves around the outside of the egg string. Chiti-

nogen layer very thick over the entire inner surface of the genital segment and abdomen.

Genus habitat.—Muscle borers, penetrating from the outside surface of the host into the underlying tissues, usually near a fin; anchored in the muscles themselves by the cephalic horns, the surrounding tissues forming a cyst around the head.

Type of the genus.—Trifur tortuosus, monotypic.

(*Trifur*, a notorious rascal in Plautus.)

Remarks.—This genus is so markedly different from the others in the family as to warrant its establishment, even upon the scanty material here recorded. The trunk is almost exactly like that of *Haemobaphes*, except that it is relatively much smaller, but the head and neck are totally different and resemble those of *Lernaeenicus*. The entire head, including the horns, and the neck are fully chitinized, instead of being soft, and the thorax segments are so completely fused as to be indistinguishable. The new genus thus combines the characters of the two older genera and becomes a connecting link between them. All the characters essential for its establishment are present, including the antennae and swimming legs, the only things lacking are the proboscis and maxillae, whose future discovery can not affect the systematic position of the genus.

TRIFUR TORTUOSUS, new species.

Plates 20 and 21, figs. 158 to 160.

Host and record of specimens.—Two females with egg strings were obtained from the outside of the body near the pectoral fin of *Salilota australis*, at Otter Bay, Smith Channel, South America. One specimen lacked the head and was cleared in clove oil to show the internal anatomy; the other was perfect, except the proboscis, and is made the type of the new genus and species, with Cat. No. 49704, U.S.N.M.

Specific characters of female.—In addition to the generic characters already given, the cephalothorax with its horns is fully chitinized like *Lernaeenicus* and *Phrixocephalus*, but totally unlike *Haemobaphes*. The long posterior horn is slightly curved, conical, and bluntly rounded at the tip: the lateral horns are smaller and shorter but also conical and blunt.

The neck is comparatively much thicker than in *Haemobaphes* and is curved in two or three different directions, chiefly sidewise at right angles to the median plane of the trunk. It is perfectly smooth, without knobs or horns, and in the cleared specimen is more than twice the length of the trunk; it does not continue the S-curve but is straight for a very short distance and then turns sidewise.

The genital segment is not much enlarged (2½ diameters), is flattened a little laterally, and is perfectly smooth except for the two wide fleshy processes over the bases of the egg strings. The abdomen is about the same diameter as the coils of the egg strings, is enlarged a little at the tip, and is without knobs or processes. It is bent in a half circle where it leaves the genital segment and is straight for the rest of its length. At the center of the posterior end is a slight sinus which indicates the position of the anus and on either side of this is a rudimentary anal lamina, without setae.

The two pairs of antennae are on the dorsal surface of the head, in a position corresponding to that in the other genera. The first antennae are short and indistinctly jointed and are turned outward away from the midline; the second antennae are rather large, are two-jointed and chelate. The majority of the rami on the swimming legs are lacking, but the basal joints indicate distinctly the position of the legs; the first two pairs are close together on the ventral surface of the head and just in front of the neck and are biramose; the third and fourth pairs are on the ventral surface of the neck, at distances behind the second pair represented by the numbers 3 and 8; the third pair is biramose and the fourth pair uniramose. From the muscles and a portion of the chitin framework left in the front of the head it is probable that the missing proboscis was similar to that in *Lernaeenicus*.

Color (preserved material), a brownish yellow, more of a brown on the head and neck, more of a yellow on the trunk; egg strings cinnamon-brown.

Total length, if straightened, 50 mm. Length of head, including posterior horn, 10 mm.; diameter, 3 mm. Diameter of neck, 1 mm. Length of genital segment, 12 mm.; diameter, 3 mm. Length of abdomen, 7 mm.; diameter, 1.50 mm. Length of egg coils, 8.50 mm.; diameter, 1.50 mm.

(*tortuosus*, full of curves and windings, alluding to the body form.)

Subfamily PENNELLINAE.

Subfamily characters of female.—Cephalothorax armed with hard chitin horns, two or three in number and unbranched; neck and trunk straight, no sigmoid curvature; genital segment only slightly enlarged and without a pregenital prominence; abdomen with branched, feather-like processes in a row along either side, often running onto the posterior end of the genital segment; anal laminae very rudimentary and destitute of setae; egg strings filiform, very long and straight, eggs uniseriate and minute, packed like a row of coins. Two pairs of antennae, the second pair chelate; a tripartite eye deeply buried over the base of the esophagus; proboscis small and

capable of but little protrusion; mandibles unknown; no maxillae or maxillipeds; four pairs of swimming legs close together just behind the head.

Subfamily characters of copepodid male (genus *Pennella*).—Body, like that of *Cyclops*, composed of a cephalothorax covered with a carapace having lateral and posterior lobes; three free thorax segments, a fused fifth and genital segment, and a one-jointed abdomen; anal laminae very short and armed with minute setae. Two pairs

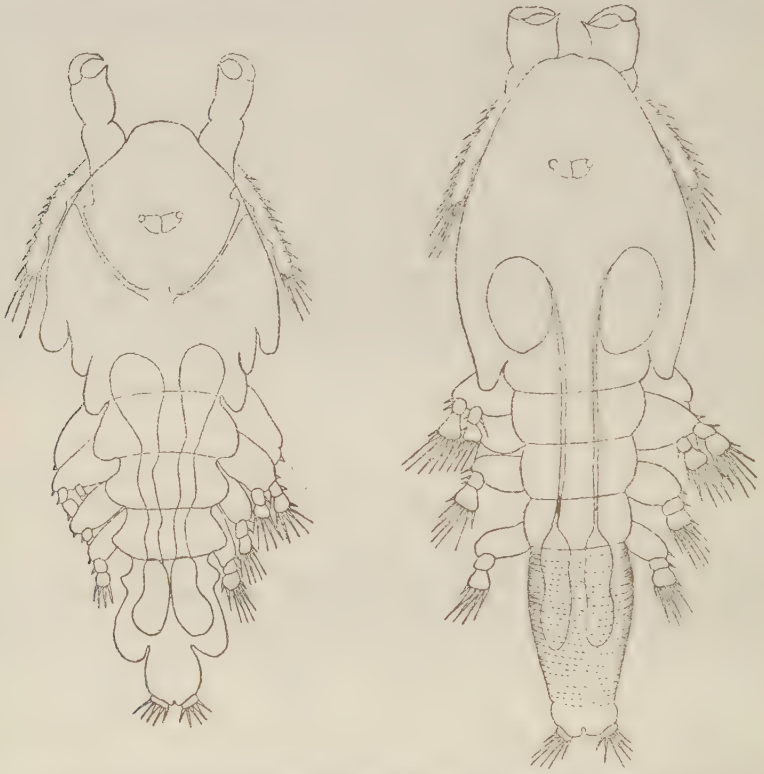

FIG. D.—THE MALE (LEFT) AND FEMALE (RIGHT) COPEPODID LARVAE OF PENNELLA VARIANS AFTER WIERZEJSKI; ACTUAL LENGTH OF FEMALE, 0.80 MM.

of antennae, second pair chelate; compound eye in the shape of a transverse spindle; mandibles stilet-shaped; two pairs of maxillae, second pair uncinate; one pair of stout, clawed maxillipeds; first two pairs of swimming legs biramose, third and fourth pairs uniramose, all the rami two-jointed. Parasites of salt-water fish exclusively.

Ontogeny of the genus Pennella.—The genital protoplasm forms egg mother cells and egg daughter cells as in the Lernaeocerinae. The oocytes acquire food and yolk material as they pass into the oviduct, in which they are strongly flattened and packed in a single row. The cement glands are separate from the oviduct and empty

into the latter just in front of the vulvae. Here each egg is covered with a membrane of the cement substance and then passes into the outer case, where it is again flattened and packed with its fellows in a single row. These eggs are much smaller in diameter than those of the other subfamilies, and as a rule there are many more of them than in the Lernaeenicinae and about the same number as in the Lernaeinae. The larva probably hatches as a typical nauplius, although this has never been observed, and is transformed into a metanauplius while swimming freely in the plankton. At the first copepodid stage the larva seeks its temporary host, which in the present instance is a cephalopod, upon whose gills are passed this and the subsequent copepodid stages. At first the larva fastens with its chelate second antennae, but with the first molt it develops a frontal filament by which it is securely anchored to the gill of the cephalopod.

Then follow pupal stages in which the segmentation of the body and its appendages becomes indistinct, the setae lose their plumes, and the various appendages become misshapen, swollen, and incapable of use. But sexual ripening goes on just the same and fertilization takes place here on the cephalopod's gills. Then comes a final molt for the female in which she acquires again well-formed appendages capable of good service. She then swims away in search of a final host, into whose flesh she burrows and is anchored by chitin horns growing out from the cephalothorax.

It is worthy of note that some species of this subfamily have been found upon whales and become thus the only copepods parasitic upon a warm-blooded animal. It may also be noticed that the members of this subfamily are the largest of the Lernaeidae, sometimes attaining the comparatively enormous length of nine or ten inches.

Genus PENNELLA Oken.

Pennatula Linnaeus, Systema Naturae, 1758, p. 819. *P. sagitta*, third species.

Pennella Oken, Lehrbuch Naturgeschichte, 1816, p. 358. Type, *P. diodontis*, monotypic, a synonym of *P. sagitta*.

Lernaeopenna Blainville, Journ. de Physique, 1822, vol. 95, p. 378. Type, *L. bocconii*, first species.

Baculus Lubbock, Trans. Linn. Soc. London, 1860, vol. 23, p. 190. Type, *B. elongatus* monotypic. A larval form of *Pennella*.

Hesselia Brady, *Challenger* Copepoda, 1883, vol. 8, p. 136. Type, *H. Cylindrica*, monotypic. A larval form of *Pennella*.

Penella, Penellus, Lernaeopinna, various authors.

Reasons for retaining the name Pennella.—Linnaeus, mistaking entirely the nature of these parasites, placed them in the genus *Pennatula* or Sea pens, and this genus name was subsequently used by Ellis (1763), Gmelin (1788), Lamarck (1818), Pallas (1772), Cuvier (1817), and others.

But *Pennatula* was the name of a genus of alcyonarian coral polyps, which gradually came into general use, and which is still retained in the group of sea fans known as Pennatulacea, with the type genus *Pennatula.*

Hence Oken, on establishing the new species *diodontis* in 1816, suggested *Pennella* as a new name for the genus and it has been universally adopted.

Thus although Linnaeus antedated Oken by many years we can not use his name for this copepod genus, but must adopt the one given by Oken.

External generic characters of female.—Cephalothorax globular, hemispherical, or semielliptical, usually somewhat flattened dorsoventrally and often with the anterior end squarely truncated and covered with short and tumid processes; the rounded posterior end gives off two or three cylindrical chitin horns, unbranched. Neck very long, cylindrical, and comparatively wide, increasing gradually in diameter and passing insensibly into the trunk. The latter is cylindrical, often transversely ridged, and straight; abdomen long and tapering to a bilobed tip, with a pair of tiny anal laminae armed with long setae; a row of appendages along either side of the abdomen, nearer the ventral surface, and branched so as to resemble the barbs and barbules of a feather. Egg strings from once to several times the length of the body, straight and filiform; eggs numerous and uniseriate. Antennae persisting in the mature adult while the two pairs of maxillae apparently disappear; first two pairs of legs close together, third and fourth pairs removed a short distance.

Internal generic characters of female.—Bilateral symmetry completely preserved; mouth tube on the anterior end of the head or on the ventral surface near the anterior margin; proboscis with a meager supply of muscles; esophagus inclined to head axis and supported by a rigid chitin framework suspended from the ventral wall of the head; stomach without convolutions or lobes; intestine straight, nearer the dorsal surface, and considerably narrowed in the abdomen; rectum short and straight.

Ovaries two-thirds the length of the trunk, tapered posteriorly, the ends distinct, the central portion more or less completely fused; oviducts with a short loop where they leave the anterior ends of the ovaries, and comparatively narrow; cement glands extending the entire length of the trunk, the ducts the same length and diameter as the glandular portion.

Chitinogen layer of body wall forming an opaque network of pigmented fibers over the inner surface of the thick chitin skin.

Genus habitat.—This genus burrows from apparently any locality on the outer body surface of its host through the skin and tissues.

and buries its head in some vital organ, forming an enormous cyst, which becomes very hard and remains a long time after the death of the parasite; it always shows torsion and sometimes flexion.

External generic characters of Copepodid male.—Cephalothorax made up of head and first thorax segment fused; second, third, and fourth segments free and diminishing gradually in width; fifth and genital segments fused; abdomen one-jointed, anal laminae short and wide.

First antennae indistinctly jointed and well armed with setae; second pair two-jointed with a stout chela; mouth tube long and barrel-shaped; mandibles without teeth; first maxillae on the outside of the tube at its base, bilobed; second maxillae on the ventral surface of the head, two-jointed and tipped with a claw; maxillipeds near the posterior margin of cephalothorax, also two-jointed and tipped with a claw; swimming legs corresponding exactly with those of the female; no fifth legs.

Internal generic characters of Copepodid male.—Esophagus short and strongly inclined to the body axis; stomach much widened in the cephalothorax, tapered posteriorly and passing insensibly into the narrow intestine. Supraesophageal ganglion comparatively small, connected dorsally with a wide tripartite eye and anteriorly with a large frontal gland secreting an attachment filament. Infra ganglion almost as large as the stomach and extending back into the second thorax segment. Testes paired and opposite each other above the stomach in the first and second thorax segments, ovate, with wide sperm ducts leading back to large spermatophore receptacles in the genital segment.

Type of the genus.—Pennella sagitta (Linnaeus), first species.

(*Pennella*, diminutive of *Penna*, a feather).

Remarks.—This genus has been probably the least understood of any in the entire family and scarcely any two authors have described their species similarly. This is partly due to the fact that specimens are often mutilated in order to save the host, since the removal of a *Pennella* in its entirety is almost certain to involve the destruction of its host as a museum specimen. It is also partly due to the presence of a much larger and tougher cyst around those portions of the body which are buried in the host; this is very difficult to remove without injury to the parasite. Again the short and stubby frontal processes, like those on a cauliflower, entirely cover the mouth and surrounding regions, and several heads must be sacrificed before gaining an adequate idea of the structure of the buccal region. In the present instance there has been an abundance of material for clearing in clove oil, for dissection, and for sectioning, and the facts here presented have been ascertained in all these ways as well as by ordinary methods.

With reference to the "male" of this genus described by Milne Edwards, Steenstrup and Lütken, Thomson, Bassett-Smith, and T. and A. Scott, it may be said that Milne Edwards briefly described a genus male but did not even mention one in connection with any of the species. He was evidently describing something which no other investigator has ever seen and which had no connection with this genus at all. Steenstrup and Lütken thought it probable that his description was not derived from his own observation, but that he mistook Nordmann's figure of a male *Anchorella* (*Clavella*) for *Pennella* and based his description upon that. Thomson, Bassett-Smith, and Scott simply translated his mistake and no one of them claimed to have seen a male.

Steenstrup and Lütken figured under *Pennella exocoeti* something which they called "The presumable pigmy male of the species." In their genus diagnosis they said that this "gave some idea of the males which had hitherto been sought in vain." But they did not mention it at all in their description of the species; evidently they were not certain that it was a male, and had no idea of its structure. Whatever it may have been, it certainly was not a pigmy male of this genus, for the males of *Pennella* are like those of the other genera in the Lernaeidae. They do not live beyond the copepodid stages, and hence are not to be found attached to the body of the adult female, nor even upon the same fish.

If one will compare carefully the copepodid males obtained by Wierzejski from the gills of three cephalopod species with the copepodid males of *Lernaeocera* described by A. Scott (1901), with those of *Sarcotretes* described by Jungersen (1911), and with those of *Lernaea* here described (p. 35), there will be no doubt that they were really what Wierzejski claimed them to be, the sexually ripe copepodid males of some *Pennella* species.

Here is the true male of the present genus, and it is one that corresponds in every particular with the other Lernaeid males already discovered. Upon Wierzejski's description and excellent figures are based the generic characters given above.

The adult females are found everywhere upon the body of their hosts and can not be said to prefer any especial locality. The large trunk of the parasite stands out from the surface of the skin, while the head and long neck are buried in the tissues of the host's vital organs. The tissue with which they come in immediate contact forms a thick and tough covering or cyst around them, which is often as large as an English walnut and sometimes attains the size of a lemon.

These cysts are usually flattened in one direction, and with age they become nearly as hard as cartilage. Inside of them the head

and neck of the *Pennella* are frequently twisted in corkscrew fashion, thereby increasing the difficulty of withdrawing them and giving the copepod a more secure hold upon its host. These cysts may be found almost anywhere in the fish's body, in the stomach and intestine walls, the mesentery, the liver, the caeca, etc. When the copepod dies the cyst simply shrivels and hardens still more, and such lumps, nearly as hard as bone, may be cut out of the liver or elsewhere alongside of the living ones.

The portion of the parasite which hangs free in the water outside the fish's skin is frequently infested with goose barnacles, hydroids, or algae. One specimen was obtained, 4 inches in length, to which were attached 18 *Conchoderma virgatum*, the mass of the barnacles being many times that of the copepod's body.

Quite recently (1912*b*) Quidor has published a paper on copepod parasites, in which he gave a diagnosis of the genus *Pennella* and then discussed its life history and specific characters. After showing that various other data did not furnish favorable specific characters, he advocated the structure of the plumose abdominal appendages and the individual torsion as a ready and infallible means of distinguishing species (pp. 202–3).

The structure of the abdominal appendages was quite thoroughly discussed by Steenstrup and Lütken in connection with *Pennella sagitta.*

While it may be possible to select plumules from the different species which will show the distinctions portrayed by Quidor, it is also possible to find on the same fish two Pennellas of the same species, fastened side by side, but whose plumules show very different structure. So long as this is likely to occur it is evident that something else must be used to separate the species. With reference to the value of torsion, if Quidor's observations were based upon the statements contained in his description of the genus, they must be profoundly modified before they will possess any scientific value. He stated: "La tête . . . présente ventralment deux antennes rudimentaires et une région buccale couverte d'appendices chitineux plus ou moins ramifiés" (p. 197); and, again: "Il (the genital segment) porteen arrière, sur la face dorsale, les orifices de ponte d'on sortent deux longs sacs ovigières filiformes." (P. 198.)

The two pairs of antennae are dorsal and not ventral, and the egg strings are ventral and not dorsal, as in every Lernaeid genus. By placing the antennae with the mouth on the ventral surface Quidor is reduced to the unhappy situation of calling the swimming legs dorsal, since they are on the opposite surface.

As a consequence all the torsion which he called direct is really inverse and his inverse torsion is really direct, because he was hold-

ing the animal with its ventral side uppermost so that right and left were reversed. Furthermore by placing the mouth on the same surface as the antennae, whether he called it dorsal or ventral, he has altered the true amount of torsion, that is, the angle between the buccal and anal orifices.

Hence what he gave as a direct torsion of 135° might well be an inverse torsion of 45°. Again his statement that "the value of the angle of torsion in the adult furnishes very precise specific characters" (p. 203) can not be proved in actual experience. No species shows anything like constancy in either the amount or the direction of torsion. We have just stated that the neck of *Pennella filosa* is often twisted in corkscrew fashion inside the cyst, but this is by no means always or even usually the case. It is evident, however, that the torsion of these corkscrew specimens will be very different from that of normal specimens, and even amongst the latter there is a wide variation. In most Pennellas the direction of torsion is clearly shown by the twisting of the color pattern on the neck. Interpreting on this basis, the torsion of five specimens of *Pennella filosa* taken from the same swordfish are: Direct 90°, inverse 180°, direct 360°, direct 360°, inverse 180°. Manifestly when two torsions are in the same direction and one is four times the other, they do not furnish a "very precise" specific character.

The only rational conclusion is that torsion in this genus has comparatively little specific value. We are forced, therefore, in making a key of the species, to rely upon an accumulation of characters, rather than upon any one or two characters alone.

Furthermore it has been found necessary to exclude the following species from the key for the reasons stated after each:

Penella anthonyi and *P. cettei* Quidor. In his attempt to use the mode of branching of the plumose appendages as the chief characteristic of the various species Quidor gave figures showing these appendages in the two species here named (1912b, pl. 1, figs. 9, 11, and 12). He also gave photographs of the two parasites, half the natural size (pl. 4, figs. 30 and 31), and a few additional facts in his key to the species. But he does not even mention them in his text, and we are left in absolute ignorance of the details of all their appendages, as well as of their general morphology.

Consequently while they may very likely prove to be new species, we can not accept them upon present evidence.

Lerneopenna blainvillii LeSueur (1824, p. 289, pl. 11, figs. 2 and 3). A synonym of *Pennella exocoeti* (see p. 115).

Pennatula bocconii Lamartinière (1798, p. 51, pl. 20, fig. 6). Milne Edwards made this a distinct species, but Steenstrup and Lütken said it was not well enough described to warrant separation and made it a synonym of *Pennella diodontis*. It was the first species (type) of

Blainville's "new genus" *Lerneopenna*. But Steenstrup and Lütken's statement holds good to-day; it has never been described with enough detail to enable it to stand as a separate species.

Lerneopenna brachiata Blainville (1822, p. 446, pl. 1, fig. 4). A synonym of *Pennella sagitta* (see p. 113).

Penella costai Richiardi (1880, p. 150). This is a *nomen nudum* and probably identical with *Pennella filosa*.

Pennella diodontis Oken, Chamisso, and Eysenhardt (1821, p. 350, pl. 24, fig. 2). A synonym of *P. sagitta* (see p. 113).

Pennella gracilis and *P. intricata* A. Costa. Carus in his Prodromus Faunae Mediterraneae (1885, p. 374) mentions these two species and ascribes them to A. Costa, but adds "Hospites, loci, descriptio?". He himself was as badly at fault since he did not give the reference in which A. Costa mentioned these species, and all efforts to find such a reference have failed.

Lerneopenna holteni Desmarest (1825, p. 347). When Desmarest transferred Holten's species, *Lernaea exocoeti*, to Blainville's genus *Lerneopenna*, he also changed the specific name. But of course there was no warrent for this and so his name, *holteni*, becomes a synonym.

Penella plumosa DeKay (1844, p. 60). DeKay described (1822, p. 87, 1 text figure) a mutilated specimen of a parasite from "*Diodon pilosus*" sent to him by Doctor Mitchill, which he was satisfied did not belong to any genus as yet established. Afterward in his Zoology of New York he evidently redescribed the same creature and gave it the above name.

Either he himself or the printer made an error in the name of the host, and gave it as "*Diodon plumosus* of this report." Fowler (1913b, p. 91) suggested that, as such a fish was not named in DeKay's report, it was proably a mistake for DeKay's "*Diodon fuliginosus*," which does appear in the report, and he made DeKay's species a synonym of *P. filosa*.

But it seems more probable that the specific name of the parasite was in some way substituted for that of the host, the two being very similar, and that DeKay was redescribing and naming the same species that he had in 1822, of which during the intervening years he had obtained better specimens. This would make it a synonym of *P. sagitta*, which infests *Diodon*, and not of *P. filosa*, which has never been found on that genus of fishes.

Penella remorae Murray (1856, p. 299, 5 text figures). This species was found attached to the sucking disk of "*Echeneis remora*," and all that was described and figured was the portion outside the disk, the part buried in the tissues of the fish having been destroyed in an attempted dissection. But this posterior portion of the parasite showed plainly that the specimens were immature, the plumose appendages having only just started to grow. A remora

could easily obtain such immature specimens while attached to some larger fish which was the regular host of the parasite.

At all events, with no data on the anterior two-thirds of the body, including all of the appendages, the species can not be accepted.

Pennella rubra Brian (1906, p. 86, pl. 7, fig. 3). This was a single specimen, without egg strings and lacking all that part of the anterior body which had been buried in the tissues of the host. This lack of egg strings, as well as the condition of the plumose appendages, show it to have been an immature stage of some species infesting the sunfish on which it was found. Brian himself afterward recognized this, and in 1912 (p. 16) placed the species as a synonym under *P. filosa.*

Pennella sultana Nordman (1864, p. 485, pl. 5, figs. 12–16). This species was first described briefly by Milne Edwards (1840, p. 523) and ascribed to Nordmann in accordance with manuscript in the Paris Museum. The manuscript was afterward published by Nordmann as above, but the species does not belong to the genus *Pennella*, and in the following year was established by Heller (1865, p. 251) as the type of the new genus *Lernaeolophus.*

KEY TO THE SPECIES OF THE GENUS PENNELLA.

1. Length 50 mm. or less, exclusive of the egg strings 2
1. Length 100 mm. or more, exclusive of the egg strings 3
2. Head spherical, the same width and length, covered with minute and regular excrescences; two soft, slender horns, 2 to 3 times the length of the head, pointed backward (10 to 20 mm.)[1] ..... *sagitta* (Linnaeus), 1758, p. 113.
2. Head much wider than long, flattened dorsoventrally, deep cut at the center, covered with large irregular excrescences; two slender horns a little longer than the head and pointed backward (40 to 50 mm.) *exocoeti* (Holten), 1802, p. 115.
2. Head wider than long, flattened dorsoventrally, squarely truncated anteriorly, not cut at the center, but covered with irregular excrescences; three soft, slender horns, the lateral ones at right angles to head and branched (30 mm.) ..... *liouvillei* Quidor, 1912, p. 116.
2. Head much longer than wide, with wing-like excrescences on either side; two stout conical horns much shorter than head and at right angles to it (15 to 25 mm.) ..... *varians* Steenstrup and Lütken, 1861.
3. Three horns, long and slender, at right angles to head, the dorsal one shorter than the lateral ones; neck slender and much longer than trunk 4
3. Two horns, short and blunt, at right angles to head; neck shorter than the trunk and nearly of the same diameter 5
3. Two horns, long and soft, pointed backwards; neck thick and as long as the trunk or longer 6
4. Neck 3 times as long as trunk; abdomen two-fifths length of genital segment; egg strings half the length of whole body; head minute and spherical (175 to 225 mm.) ..... *antarctica* Quidor, 1912, p. 116.

[1] Average total length of species.

4. Neck 2 times as long as trunk; abdomen half the length of genital segment; egg strings half the length of whole body; head flattened, much wider than long (200 to 320 mm.)_____*balaenopterae* Koren and Danielssen, 1877.

4. Neck and trunk the same length; abdomen two-fifths length of genital segment; egg strings twice the length of whole body; head flattened, much wider than long (140 mm.)_____*tridentata* Listowsky, 1893.

4. Neck 2 to 3 times as long as trunk; abdomen three-fifths length of genital segment; head cup-shaped anteriorly (90 to 125 mm.)
crassicornis Steenstrup and Lütken, 1861.

5. Horns chitinous, at right angles to head, and both in the same straight line; abdomen half the length of genital segment; egg strings no longer than abdomen (90 to 100 mm.)_____*histiophori* Thomson, 1889.

5. Horns fleshy and very short, terminating in a small red knob; abdomen half the length of genital segment; egg strings much longer than whole body (100 mm.)_____*pustulosa* Angas, 1847.

5. Horns chitinous, slender, and scarcely projecting beyond the margins of the head; abdomen stout and less than half the length of genital segment; egg strings twice the length of whole body (150 to 200 mm.)
filosa (Linnaeus), 1758, p. 119.

6. Head squarely truncated anteriorly, with concave sides; horns parallel with the neck; neck and trunk the same length; abdomen half the length of genital segment (225 mm.)_____*instructa*, new species, p. 122.

6. Head cup-shaped anteriorly, with convex sides; horns extending diagonally outward; neck one-fifth shorter than trunk; abdomen a third the length of genital segment (180 mm.)_____*orthagorisci* Wright, 1870, p. 124.

6. Head shaped like a clove, largest anteriorly; horns parallel with neck; neck 3 times as long as trunk; abdomen half as long as the genital segment (275 mm.)_____*charcoti* Quidor, 1912.

PENNELLA SAGITTA (Linnaeus).

Pennatula sagitta Linnaeus, Systema Naturae, 1758, p. 819, pl. 3, fig. 13.—Ellis, Philos. Trans., vol. 53, 1763, p. 419, pl. 1.—Cuvier, Regne Animal, vol. 4, 1817, p. 36.—Dekay, Amer. Journ. Science, vol. 4, 1822, p. 87, 1 text fig.

Lerneopenna sagitta Blainville, Journ. de Physique, vol. 95, 1822, p. 379, pl. 1, fig. 5.

Lerneopenna brachiata Blainville, Journ. de Physique, vol. 95, 1822, p. 446, pl. 1, fig. 4.

Pennatula bocconii Lamartinière, Atlas du Voyage de la *Pèrouse*, 1798, pl. 20, fig. 6.

Lernaea diodontis Oken, Lehrbuch Naturgeschichte, 1816, p. 184.

Pennella sagitta Nordmann, Mikrographische Beiträge, 1832, p. 121, pl. 10, figs. 6–8.—Steenstrup and Lütken, Kong. Danske Videns. Skrifter, 1861, p. 409, pl. 14, fig. 31.

Pennella diodontis Oken Lehrbuch Naturgeschichte, 1816, p. 358.

Pennella diodontis Oken, Chamisso, and Eysenhardt, Nova Acta Acad. Caes. Bonn, vol. 10, 1821, p. 350, pl. 24, fig. 3.

Pennella diodontis Quidor, Deuxième Expédition Antarctique, Charcot, 1912, p. 205, pl. 1, fig. 2; pl. 2, figs. 19–22; pl. 4, fig. 38.

Remarks.—As the above synonomy shows, various authors have attempted to establish 4 or 5 different species upon the material obtained from the genus *Diodon*. Linnaeus made the mistake of

placing this copepod among the sea fans, and this error was copied by Ellis, Lamarck, Esper, and others, each of whom described the creature simply from a figure given by one of the others. Cuvier recognized that it did not belong with the polyps, but he went too far in the opposite direction and declared that it must be considered as belonging to the genus *Caligus* of Müller.

In a later edition (1830) he adopted Oken's genus *Pennella* under the Lerneans (vol. 3, p. 256), but included in it only the single species, *filosa*.

However, on page 320 in a footnote under the polyp genus *Pennatula* he said: "*Pennatula filosa*, et *Pennatula sagittata*, sont des animaux parasites, du genres des lernèes (les *Penelles*, Oken); mais nullement des pennatules. Le *Penn. sagitta*, Esper, Pennat., pl. V, est tout autre chose que celui de Linn.; peutètre est-ce un *Nephthys*."

De Kay, after noting the above treatment of the parasite, said: "This animal has been first ranked as a *Lernea*, a parasite, then considered as a pennatule or polype, afterwards placed in the genus *Calygus* as a crustaceous animal, and finally, it has been decided that it shall occupy a new genus as an Annelide." (p. 88.) He then gave an incomplete description of a mutilated specimen from "*Diodon pilosus*," sent to him by Doctor Mitchill, together with a text figure. The head, the neck, and the anterior portion of the genital segment were lacking, the specimen having evidently been broken off on a level with the outside surface of the host's skin.

Consequently the only portion of his description of any scientific value was that of the "plumulae" and the name of the host. And it is not surprising that he finally concluded to place the animal in one of the four genera established by Lamarck under the order of "Polypes tubiferes," thus restoring it to the polyps.

Blainville described in his text a species which he claimed was the *sagitta* of Linnaeus, Ellis, Esper, Lamarck, and DeKay (p. 379), But he manifestly never saw the creature; his description is borrowed from those of the other authors, and for a figure he copied the imperfect wood cut of DeKay. Indeed, he comprehended so little about the size and structure of the species that he described it again in the explanation of his plate (p. 446) as a new species, to which he gave the name *brachiata*.

Nordmann gave us the first really scientific description of this parasite, accompanied by excellent colored figures. He identified his species with that described by Linnaeus and the others, and if his identification was correct, as we have no reason to doubt, it established the species of those early writers beyond question. And since it was the first parasite described by Linnaeus it becomes the

oldest of the parasitic copepods. With reference to the host, Linnaeus's specimens were taken from the sargassum fish, *Pterophryne histrio*, that of DeKay was from a *Trichodiodon* (*Diodon*) *pilosus;* Blainville's *sagitta* was from a species of *Lophius* in the Sea of China, while his *brachiata* was from a *Diodon* at Manila, Philippine Islands; Nordmann's species was taken from *Lophius marmoratus*, but he identifies it with DeKay's specimen from *Diodon.*

The species thus becomes a parasite of the two genera, *Lophius* and *Diodon.*

PENNELLA EXOCOETI (Holten).

Lernaea exocoeti Holten, Skrivter af Naturhistorie-Selskabet, vol. 5, 1802, p. 136, pl. 3, fig. 3.

Lerneopenna holteni Desmarest, Crustacés, 1825, p. 347.

Lerneopenna blainvillii LeSueur, Journ. Acad. Nat. Sci. Phila., vol. 3, 1824, p. 289, pl. 11, figs. 2 and 3.

Penellus blainvillii Milne Edwards, Hist. Nat. des Crustacés, 1840, p. 523.—Flower, Proc. Zool. Soc. London, vol. 26, 1858, p. 372.

Pennella exocoeti Steenstrup and Lütken, Kong. Danske Videns. Selskabs Skrifter, vol. 5, 1861, p. 415, pl. 14, fig. 33.

Penella exocoeti Quidor, Deuxième Expédition Antarctique, Charcot, 1912, pl. 1, fig. 3; pl. 4, fig. 39.

Remarks.—Holten gave a fair description and figures of this species, which were copied by Desmarest without any additions from original investigation, but with a change of name to correspond with Blainville's newly established genus. Steenstrup and Lütken obtained three specimens from an *Exocoetus* species captured in the tropical Atlantic, which they positively identified with Holten's species, and of which they gave excellent figures, but added nothing to Holten's description. So far as can be judged from a comparison of the respective figures and descriptions, their identification was correct, but neither description gives us very much in the way of details. They also discovered just above the base of the egg strings two tiny objects which they called pigmy males, and which they said "were fastened to the skin of the female so tightly by their maxillipeds that it was not possible to loosen them without tearing them in pieces" (p. 419). These were not placed with the females under the species *exocoeti*, but were put in the general remarks after all the species, and without any description. The simple fact that they could not be removed from the female without tearing them in pieces indicates that they were not males. The two sexes are never welded together in any such manner as that, and the only injury that would be possible would be the loss of the claws on the maxillipeds or perhaps of the entire appendages. Steenstrup and Lütken further stated that "the *P. blainvillii* described by LeSueur was also taken

from an *Exocoetus* (*E. volitans*) but differs from ours (namely from *exocoeti*) both in the older and the younger stages so much that we may regard it as quite distinct" (p. 415).

A careful comparison of LeSueur's figures and description with those of Steenstrup and Lütken does not show any differences of specific value.

Blainvillii has three horns, all of a length and quite short and the neck is short and stout; *exocoeti* has only two horns while the neck is long and threadlike. But neither of these differences nor both of them are sufficient to separate the two species; much more accurate and detailed descriptions must be given before we can definitely establish them as distinct species, infesting the same host and in the same locality.

PENNELLA LIOUVILLEI Quidor.

Pennella liouvillei QUIDOR, Deuxième Expédition Antarctique Française, Charcot, 1912, p. 209, pl. 1, fig. 1; pl. 2, fig. 26; pl. 3, fig. 28; pl. 4, fig. 37.

Remarks.—This species of Quidor differs from *exocoeti* only in the possession of a dorsal cephalic horn, in the branching of the lateral horns, and in the fact that the inflated lateral portions of the head do not project in front of the central portion. Quidor added that the torsion was direct in *exocoeti* and inverse in *liouvillei*, and if we can judge from his text this is the difference which induced him to establish his new species. But it has been shown elsewhere (p. 109) that torsion has no specific value, and the other differences might all result from different conditions encountered while the parasite was penetrating the tissues of its host. Hence there is need of more details here also before the species can be definitely established.

PENNELLA ANTARCTICA Quidor.

Plate 15, figs. 119–124.

Pennella antarctica QUIDOR, Deuxième Expédition Antarctique Française, Charcot, 1912, p. 206, pl. 1, figs. 15–17; pl. 4, figs. 29, 34.

Host and record of specimens.—Two females out of a lot that were taken from the Sei whale, *Balaenoptera borealis*, off northern Japan by Dr. R. C. Andrews of the American Museum of Natural History, New York City, were presented to the National Museum and have received Cat. No. 47820, U.S.N.M.

Specific characters of female.—Head distinctly separated from the first thorax segment by a deep groove, ellipsoidal with the long diameter transverse, and flattened somewhat dorsoventrally; divided into two halves by a longitudinal furrow, which is wide and shallow, beginning at the antennae on the dorsal surface, extending around

the anterior margin, and running the whole length of the ventral surface to the neck. Ventrally the anterior two-thirds of this furrow is filled with the small horny frontal processes, those along the margin of the groove larger than those along the bottom. First two thorax segments as wide as the head, fused and separated from the third and fourth segments by a groove; they give off a pair of long and slender lateral horns and a much shorter dorsal horn.

Third and fourth segments also fused, narrower than the two first segments and tapered posteriorly; neck very long and threadlike, only the extreme anterior portion being yellow and chitinous, while the rest is softer and the same color as the trunk. The latter is comparatively short and not much enlarged, its surface being raised into irregular transverse ridges, lighter in color than the intervening grooves. Posteriorly its dorsal portion passes into the abdomen, which is short, tapering, transversely ridged like the trunk, and bluntly rounded at the tip.

Each barb of the plumose appendages is single and branched on only one side; the first one or two branches (barbules) are much larger than the others and are themselves dichotomously divided; the egg strings are comparatively short and slender.

The first antennae are removed some distance behind the second pair, are three-jointed, and well armed with setae. The second antennae are two-jointed and tipped with a chela; the basal joint is triangular, the apex of the triangle being attached to the dorsal surface of the head and the base being articulated with the terminal joint; the claw of the chela is stout and strongly curved, the peg is short and considerably inclined inward toward the opposite antenna.

The mouth tube is reduced to a mere fringe around an opening on the ventral surface of the head, in the bottom of the groove and near the sinus in the anterior margin. No mouth parts can be seen, but instead the groove around the mouth is filled with the corneous frontal processes.

Buried deeply in the tissues over the base of the esophagus is an eye which still retains the two lateral lenses found in larval forms.

The four pairs of swimming legs are all present, the three posterior pairs placed at distances behind the anterior pair represented by the numbers 5, 17, 28; the first two pairs are biramose, the last two uniramose, all the rami two-jointed and bearing setae.

The structure of the mouth framework is clearly shown in figure 123; the esophagus is surrounded by a chitin ring (*cr*) oblong in shape, somewhat angular and attached to the inside of the wall of the head. From each of its four corners and from the center of either side a short and wide chitin band (*cb*) projects dorsally into the cavity of the head.

To the ends of each band and all over the dorsal surface of the ring numerous muscle bands are attached, which have their origin on the dorsal and posterior walls of the head. Similar muscle bands are inserted all over the ventral wall of the head around the mouth, on the soft membranes as well as on the harder chitin parts. These also have their origin on the dorsal, lateral, and posterior walls of the head, so that the entire cavity, except for the digestive tube, is filled with these muscle bands.

Their contraction pulls in the ring and the portions of the ventral wall around the mouth as far as the elasticity of the chitin and the soft membranes will permit. The entire front of the head thus takes the place of the protrusible proboscis in other genera.

The esophagus, after passing through the ring, turns forward and opens on the ventral surface of the head in the space between the anterior bands (*oe*). There is a posterior prolongation (*p*) which extends backward between the ring and the ventral wall of the head, and ends blindly between the posterior bands. Behind this prolongation posteriorly and along either side of the ring are irregularly rounded areas (*m*) in the ventral wall of the head, which are covered with a fairly thin, soft membrane instead of the hard chitin. Between these areas and outside of them the walls are thick and hard; the frontal processes cover both the hard chitin and the soft membranes indiscriminately, and can be removed from the latter as well as the former without injury. The number, size, and arrangement of these soft membranes furnish good specific characters.

Color (preserved material), head and anterior fifth of the thorax dark yellowish brown; remainder of thorax and trunk light yellow on the dorsal and ventral surfaces and dark brown along the sides; plumose appendages silver gray; egg strings light yellow.

Total length, 235 mm. Head, 4 mm. long, 5 mm. wide. Lateral horns, 35 mm. long. Genital segment, 50 mm. long, 4 mm. wide. Abdomen, 18 mm. long. Egg strings, 100 mm. long.

(*antarctica*, the region from which the original specimens came.)

Remarks.—One of the specimens was an exceptionally fine one, and the above description has been given in order to supplement the one presented by Quidor and to correct certain errors.

Quidor found but a single pair of antennae and he designated as first maxillae two chitin knobs, one on either side, in the sinus of the frontal margin, and thus in front of the mouth, between it and the antennae; two others on the ventral surface were designated as second maxillae, and only three pairs of legs were found.

The species may be recognized by the exceptionally long and slender neck and by the three horns on the first thorax segment, the two lateral ones being long and inclined forward.

PENNELLA FILOSA (Linnaeus).

Plate 15, figs. 125–127; plate 16, figs. 128–133; plate 17, figs. 134–139.

Pennatula filosa LINNAEUS, Systema Naturae, 1758, p. 819.

Lernaea cirrhosa LA MARTINIÈRE, Atlas du Voyage de la *Pérouse*, 1798, pl. 2, fig. 6.

Penellus filosa MILNE EDWARDS, Hist. Nat. des Crustacés, 1840, vol. 3, p. 523.

Penella filosa QUIDOR, Deuxième Expédition Antarctique Française, Charcot, 1912, pl. 1, figs. 5–8; pl. 4, figs. 35, 36.

Pennella filosa CUVIER, Règne Animal, 1830, vol. 3, p. 257.—M. T. THOMPSON, Biological Bulletin, 1905, vol. 8, p. 296, 6 text figs.—BRIAN, Résultats Scientifiques Prince de Monaco, fasc. 38, 1912, p. 16, pl. 3, figs. 2–4; pl. 6, fig. 10.

Pennella rubra BRIAN. Copepodi parassiti dei Pesci d'Italia, 1906, p. 86, pl. 7, fig. 3.

Host and record of specimens.—The following specimens of this parasite appear in the United States National Museum collection; Cat. No. 3155, one female from a swordfish captured off the coast of Nova Scotia; Cat. No. 6143, two females from *Mola rotunda*, off Marthas Vineyard; Cat. No. 6144, two females from a swordfish, Woods Hole, Massachusetts; Cat. No. 42298, twelve females much infested with barnacles from an unknown locality and host; Cat. No. 42307, seven females from swordfish at Woods Hole; Cat. No. 42313, ten females from swordfish, Woods Hole; Cat. No. 47754, five females from sunfish, Woods Hole, much infested with barnacles; Cat. No. 47755, eight heads only from swordfish, Woods Hole; Cat. No. 47821, one female from *Mola rotunda*, Woods Hole; Cat. No. 47822, two females from *Tetrapturus albidus*, north Atlantic.

Specific characters of female.—Cephalothorax subspherical, wider than long, slightly flattened dorsoventrally, and almost squarely truncated at the anterior end, which is covered with short processes. These processes are usually branched like those on a cauliflower, especially around the edges, but some of them are simple. Where the head joins the neck a pair of short, straight, and unbranched horns are given off on the dorsal surface, and there is often a shorter third one between them.

On the dorsal, lateral, and ventral surfaces of the head, near the beginning of the processes at the anterior end, there are usually several small knobs, irregularly disposed and never alike in any two specimens.

Neck comparatively thick, about the same diameter throughout, and considerably shorter than the genital segment. The latter is about twice the diameter of the neck and transversely ridged, increasing gradually from the neck and then remaining the same diameter for the rest of its length.

Abdomen half the length of the genital segment, plumes large and profusely branched, usually with tertiary plumules. Egg strings very slender and often several times the length of the body; one of the specimens in lot No. 42313, which was itself 120 mm. in length outside the fish's body, had egg strings 350 mm. long.

First antennae slender and three-jointed, close to the bases of the second pair and turned forward, the joints of about the same size and heavily armed with setae. Second antennae two-jointed, joints the same size, the terminal one chelate, a stout and strongly curved claw shutting past a large peg on the inner margin of the joint. Between the basal joints is a short, pointed rostrum, with the usual pigment spot at its center, and a tripartite eye is deeply buried in the tissues over the base of the esophagus; there are no visible mouth parts. The basal plates of the swimming legs are slender and elongated-triangular in shape, the intervals between the successive pairs being represented by the numbers 10, 30, 35 respectively.

The structure of the mouth framework is shown in figures 130–131. The chitin ring around the esophagus is short and wide, concave anteriorly and bluntly rounded posteriorly, with only four chitin bands projecting into the cavity of the head, one at each anterior corner and one at the center of either side. There is but a single semielliptical area on either side covered with thin and soft membrane; each of these areas starts just in front of the lateral chitin band and extends backward nearly to the posterior margin of the head. It is surrounded by a wide chitin band or ridge, the bands on the inner sides of the areas meeting along the median line, except for a short distance posteriorly. The arrangement of the muscles and frontal processes with reference to these areas and bands is similar to that in *Pennella antarctica*.

Immature stages.—A young *P. filosa*, 18 mm. in length, taken from a swordfish, is shown in figures 135–139. The antennae and swimming legs are the same as in the adult, but in contrast to the latter all the mouth parts are present and are very distinct. The proboscis projects considerably from the ventral surface of the head and is evidently retractile. Inside of it at its base lie the mandibles, which are made up of a broad lamellate basal joint, tipped with a curved spine without teeth. The stout muscles connecting the basal joint with the inner walls of the head show that these organs take a prominent part in the early activities of the parasite, and may even assist in burrowing through the flesh of its host. The first maxillae are tiny projections on the side walls of the proboscis, each tipped with two long setae. The second maxillae are long and stout; each consists of a basal joint armed with two strong claw-like spines, one on the ventral surface near the distal end and the other at the end on the lateral margin, and a distal joint armed with two claws, one

terminal and slightly curved, the other on the inner margin near the base. These appendages are also furnished with very powerful muscles and are probably used in burrowing. The maxillipeds are reduced to mere spines, with which are still connected two or three weak muscles whose only service seems to be to show that the spines are really rudiments of mouth parts. In the posterior end of the genital segment, just inside the vulva, can be seen the enlargement of the oviduct on either side which serves as a receptaculum seminis. The entire abdomen is monilliform and terminates in two large anal laminae, each well supplied with setae.

In an older specimen, 35 mm. long, the rudiments of the mixillipeds have disappeared, but the other appendages remain intact; the genital segment is ridged transversely, and the plumose appendages of the abdomen have started as broad bluntly rounded processes, one on either side of each monilliform division of the abdomen.

Color.—Head and neck, or buried portions of the body, pale yellow, often with a reddish tinge from the contained blood; genital segment and abdomen dark cinnamon brown, banded transversely with yellow; egg strings dark orange yellow.

Total length, 150–200 mm. Head, 8 mm. long, 10 mm. wide. Neck, 50–60 mm. long, 3 mm. wide. Genital segment, 70–80 mm. long, 6 mm. wide. Abdomen 40–50 mm. long. Egg strings 200–350 mm. long.

(*filosus*, thread-like.)

Remarks.—The history of this species is rather complicated. Linnaeus described his *Pennatula filosa* as follows: "P. stirpe rachi utrinque pennata: basi tentaculis duobus. Bocc. mus., 1674, p. 286, t. 286. Habitat in M. Mediterranei Xiphiis. Setae 2, rubrae, ad basin rachios pennatae insertae, ipsaque rachi longiores."[1]

Stebbing pertinently remarked[2] that the only thing of any specific value in this description was the name of the host. But, fortunately, subsequent investigators have added useful characters that do possess specific value.

Guerin-Meneville published[3] a figure of *Pennatula filosa* that shows enough details to identify the species. Cuvier said,[4] "There is one species (*Pennella filosa*) in the Mediterranean, 7 or 8 inches long, which penetrates the flesh of the swordfish, the tunny, and the sunfish, and torments them horribly." Milne Edwards added,[5] "Body very long, slender, and straight; head swollen, carrying behind two short and obtuse horns. Appendages of the abdomen penniform, slender, and joined two by two at their base."

[1] Systema Naturae, ed. 10, 1758, p. 819.
[2] South African Crustacea, 1905, pt. 3, p. 188.
[3] Regne Animal, 1837, vol. 2, pl. 9, fig. 3.
[4] Idem, 1830, vol. 3, p. 257.
[5] Histoire Naturelle des Crustaces, vol. 3, p. 523.

Steenstrup and Lütken[1] said that if it should prove that several closely related species had been combined under the single name *filosa*, the species from the Mediterranean swordfish must be considered as the type, which is obviously true. But these authors attempted no further identification of the species.

No other investigator did more than to mention the species until Brian in the Bulletin de l'Institut Oceanographique (No. 110, 1908, p. 8) described at considerable length and illustrated with text figures both the development stages and the adult female. In this paper he placed a question mark after the species, but in a subsequent paper[2] he dropped the question mark and was satisfied with the identity of the species. His specimens were obtained from *Orthagoriscus mola* in the Atlantic west of the Azores. The present author has found both adults and development stages of the same parasite upon the swordfish.

Finally Quidor[3] has given us photographs of the entire animal and careful drawings of the plumose appendages of the abdomen from which we can easily identify the species. His specimens were found both on the swordfish and the sunfish on the northern coast of France.

With the details here added in reference to the antennae, the chitin framework supporting the esophagus, and the mouth parts of the development stages this species ought to be securely established.

PENNELLA INSTRUCTA, new species.

Plate 18, figs 141–147.

Host and record of specimens.—The United States National Museum collection includes the following specimens, all taken from the swordfish, *Xiphias gladius:* No. 3691, two females, by steamer *Lookout* from Atlantic off New England; No. 6159, one female, by the fisheries steamer *Albatross*, northern Atlantic; No. 14574, one female, from Maine coast; No. 47750, a single female with the cyst which enclosed its head and neck, from Woods Hole, Massachusetts, made the type of the species; No. 47751, eight females with their cysts, from Woods Hole; No. 47752, five females, from Woods Hole; No. 47753, four heads with horns intact, taken from cysts found inside the body of a swordfish, Woods Hole.

Specific characters of female.—Cephalothorax swollen, considerably longer than wide and squarely truncated anteriorly, with the lateral walls slightly concave. This hollowing in of the sides of the head is due to large swellings at the bases of the horns posteri-

[1] Kong, Danske Videns, Salskabs, Skrifter, 1861, vol. 5, p. 416.

[2] Campagnes scientifiques due Prince de Monaco, fasc. 38, 1912, p. 16.

[3] Deuxième Expédition Antarctique Française, Charcot, 1912, pl. 1, figs. 5–8; pl. 4, figs. 35, 36.

orly and an elevated ridge around the margin of the anterior truncated end. Frontal processes arranged in a definite pattern, consisting of a semicircle on either side around the margin, two shorter bunches inside of them curved like parentheses marks, and two narrow straight masses through the center dorsoventrally. (See fig. 143.) There is a wide, open space without processes between the semicircle and the parenthesis mark on either side, and a narrower space between the parenthesis mark and the central mass, so that the pattern stands out very distinctly.

At the posterior end of the cephalothorax nearer the dorsal surface there is a single long horn on either side, which tapers gradually to a bluntly rounded point, extends directly backward alongside the neck, and is curved considerably forward toward the ventral surface. The chitin skin over these horns is very thin, and in consequence the horns are soft and pliable. The neck is not enlarged anteriorly, but starts abruptly from the back of the head between the horns, is the same diameter throughout, and is much longer than the trunk. The latter is twice the diameter of the neck and is transversely ridged; abdomen half the length of the genital segment; plumules about 24 in number along each side of the abdomen, quite long and dichotomously branched; egg strings very slender and longer than the entire body.

First antennae four-jointed, each joint heavily armed with setae, separated from the second pair by a considerable distance (fig. 145); the third joint is the shortest and narrowest, while the fourth or terminal joint is the longest and widest. Second antennae large and stout; basal joints triangular, considerably smaller than the terminal joints and widely separated across the midline; second or terminal joints swollen, with a stout and strongly curved claw, which shuts against a medium-sized peg on the inner margin of the joint. Between the basal joints is a wide chitin plate, in the center of which is a large and bluntly pointed rostrum with a pigment spot in its base. The chitin ring surrounding the esophagus is diamond-shaped, with the two obtuse angles lateral, and each of them giving off a wide chitin band; the other two bands are on either side of the anterior point. The arrangement of the chitin ribs and soft membranes is exactly like that of the frontal processes, the soft membranes under the open spaces, the ribs under the processes.

The swimming legs each have a large spot of pigment on the basal joint and the different pairs are separated by distances corresponding to the numbers 1, 5, 6.

Color.—Head and buried portion of the neck brownish yellow; trunk dark cinnamon brown with interrupted transverse bands of yellow; plumose appendages dark steel-gray.

Total length, 225 mm. Head 7 mm. long, 8 mm. wide, 7 mm. thick. Neck, 110 mm. long, 2.50 mm. in diameter. Genital segment, 75 mm. long, 6 mm. in diameter. Abdomen, 40 mm. long. Egg strings, 330 mm. long.

(*instructus*, arranged in definite order, alluding to the frontal processes.)

Remarks.—This species may be recognized by the peculiar pattern in which the frontal processes are arranged and by the two curved horns given off from the posterior margin of the cephalothorax. The long distance between the first and second antennae, and the comparatively long distance to which the third and fourth legs are removed are also characteristic. This is undoubtedly the "*Penella* sp?" described by Brian in his preliminary note on the parasitic copepods taken during the scientific voyages of the Prince of Monaco[1]; his figures, especially of the head and horns, are unmistakable. This species infests the swordfish together with *filosa*, and has not thus far been found upon any other host. The cysts formed around the head and neck in the tissues of the host are very large, and inside of them there is more or less twisting and flexure.

While the part of the body outside of the host does not apparently afford as good lodgement for *Conchoderma* as was the case in *filosa*, it does prove attractive to hydroids and algae, and is often very heavily loaded with one or both of them.

PENNELLA ORTHAGORISCI Wright.

Pennella orthagorisci WRIGHT, Ann. Mag. Nat. Hist., ser. 4, vol. 5, 1870, p. 43, pl. 1.

Host and record of specimens.—A single lot of 10 females were obtained from *Mola mola* at Woods Hole, Massachusetts, and have received Cat. No. 42299, U.S.N.M.

Specific characters of female.—Wright fully described this species in the reference above given, but he had only two specimens obtained in the harbor of Cork, Ireland. The following notes by Mr. Richard Rathbun upon the 10 specimens obtained at Woods Hole will therefore be of interest by way of comparison:

Cephalic horns generally three in number, but sometimes only two, as in Wright's figure; they originate from the base of the cephalic region, close to the neck, and often so exactly between the two that it is difficult to say to which they properly belong. When only two they originate much farther apart than in Wright's figure, very near or quite at the sides of the head toward the dorsal surface. When three in number the third one springs from the dorsal surface midway between the other two, sometimes reduced to a mere knob, at others attaining a length two-thirds that of the lateral horns, but

[1] Bull. de l'Instit. océanog., No. 110, 1908, p. 6.

never equaling them. None of the lateral horns were as long as in Wright's figure, and they were usually slender, the stoutest ones measuring 2 mm. in diameter. They sometimes taper and sometimes enlarge toward the tip, are of about the same size and length on the two sides, and usually project at an angle of 45°.

The head varies in the proportion of length to breadth, but is always wider than long, rarely twice as wide as long; it is generally divided into two lobes, though sometimes obscurely, by a groove which runs the length of the ventral surface, makes a slight depression on the frontal margin, and disappears on the dorsal surface. The anterior end of the head is more or less flattened, rarely slightly concave, and is inclined toward the ventral surface. This flattened portion is covered with frontal processes branched like cauliflowers, which are packed closely together, are quite uniform in size, and present an even contour.

The proboscis is elongated dorso-ventrally and is completely hidden by the frontal processes, which form a double ring or band about it, the separation between the two rings being only slightly but usually distinctly indicated. Along the anterior margin of the head are a number of small protuberances similar to, but larger than, the frontal processes, with which they are usually continuous. There is one on each side of the longitudinal groove, those on the ventral side being nearer together, those on the dorsal side farther apart. On the sides of the head there may be anywhere from one to eight of these processes, not regularly placed, and often more or less digitate like cauliflowers.

The antennae are situated somewhat in front of the center of the dorsal surface, about one-third of the distance from the anterior margin. The integument covering the head is very thin and yielding to the touch; the horns and the anterior thorax are much more rigid.

The thorax varies considerably in length; anteriorly it joins the head abruptly, retains a uniform width for most of its length, and enlarges gradually at the posterior end to meet the trunk. The latter is ribbed transversely, the ribs being sometimes quite prominent, at others but faintly indicated. It is of uniform diameter (twice that of the neck) as far back as the vulvae, where it is abruptly constricted to two-thirds its former diameter, and from thence tapers gradually to a bluntly rounded tip.

The filamentous appendages are very numerous and dense, and are directed backward and ventrally, leaving the dorsal side of the abdomen clear; they extend slightly beyond the anus.

The swimming legs are just behind the head, where they occupy one and a quarter to one and a half millimeters of linear space. The two anterior pairs are close together and overlap more or less, while

the interspaces between the second and third and the third and fourth pairs are comparatively large and subequal.

Color.—Head and horns light brown, trunk dark olive brown, the grooves between the ribs lighter in color; egg strings gray white; plumose appendages a deep black.

Total length, exclusive of egg strings, 160 to 180 mm.

(*orthagorisci*, the former generic name of the host.)

Remarks.—This species differs from *instructa*, just described, in the following particulars: The head in the present species is always wider than long, while in *instructa* it is always longer than wide; the horns are usually three and are chitinous, while in *instructa* there are never but two, which are soft in texture; the trunk is comparatively three times the length and twice the diameter of that in *instructa;* the first antennae are so close to the second pair that their bases touch, while in *instructa* they are far removed; Wright represents the second antennae as definitely three-jointed and slender, while in *instructa* they have but two joints and are fully as wide as long.

Genus PEGESIMALLUS Krøyer.

Pegesimallus KRØYER, Bidrag til Kundskab om Snyltekrebsene. 1863, p. 332, pl. 18, fig. 7.

Generic characters of female.—Body made up of five distinct parts: First, an elongate-ovate head, destitute of antennae and mouth parts, but with a small proboscis; second, a short and slender neck; third, a thicker posterior neck covered with excrescences resembling bunches of grapes; fourth, a vermiform anterior trunk, transversely ridged, with a ventral row of soft processes along either side of the midline; fifth, a posterior trunk, in three coils, and covered with villous processes.

Remarks.—The above is adapted from Krøyer's generic diagnosis and gives the principal characters of this parasite. He had but a single specimen which was found amongst some Greenland crabs that were sent to him.

There is nothing in the description or in the figures to show that this is a copepod and not a worm, as there were no egg strings.

It may be a copepod not fully developed and covered with Gymnoblastic Hydroids like those described by Jungersen.[1] But we must have many more details of its structure before we can decide where to place it; meanwhile it may be left here among the Lernaeans where Krøyer located it, with the understanding that its presence is very questionable.

[1] Vidensk. Meddel. fra naturh. Foren., vol. 64, 1911, p. 21.

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1847. ANGAS, GEORGE FRENCH. On a new Species of Penella. Ann. Mag. Nat. Hist., ser. 1, vol. 19, p. 280, text figure.

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1897. ANONYMOUS. A Parasitic Crustacean on a Flying-fish. Bull. Liverpool Museum, vol. 1, pp. 23–24, 1 text figure. *Pennella exocoeti.*

1916. ————. The Feathers of the Flying Fish. Agricultural News, West Indies, vol. 15, No. 360, p. 63, 1 text figure.

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1905. ANTHONY R. and CALVET L. Recherches faites sur la Cétacé capturé à Cette le 6 octobre 1904 (Balaenoptera physalus [Linné]). 1re. Partie. IV, Parasites extérieurs. Bull. de la Soc. phil. Paris (9), vol. 7, pp. 80–85, 1 text figure. *Pennella balaenopterae.*

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330 B. C. ARISTOTELES. De Historia Animalium. Published in 50 volumes.

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Placed the Lernaeans in the second class of Zoophytes, the Entozoa, vol. 3, pp. 255–258 and divided them into 7 groups, Les Lernées propres, Les Pennelles, Les Sphryions, Les Anchorelles, Les Brachielles, Les Clavelles, and Les Chondrachanthes.

1822. DE KAY, JAMES E. Observations on the "Pennatule flèche" (P. sagitta of Lamarck) in the Cabinet of Dr. Mitchill. Amer. Journ. Sci., vol. 4, pp. 87–8, 1 text figure.

Described and figured a mutilated specimen, and called attention to the fact that it had been ranked first as a Lernaean, then as a Pennatula or polyp, afterwards as a *Caligus* or copepod, and finally as an annelid. He himself restored it to the polyps.

1844. ————. Zoology of New York or the New York Fauna. Part VI, Crustacea. Albany, 1844.

Parasitic copepods, pp. 57–60, pl. 10, figs. 44–47. *Lernaea cruciata*, p. 59; *Lernaea* (*Lernaeenicus*) *radiata*, p. 60; *Penella plumosa* and *P. filosa*, p. 60. He made this *P. plumosa* a new species, but it was probably the same as the *P. sagitta* described in 1822 (see p. 111).

1823. DESMAREST, ANSELME GAETAN. Article Malacostracés. Dictionaire des Sci. Nat., vol. 28, pp. 138–425.

An effort to supply the omissions in the articles on the Crustacea in the Dictionaire occasioned by the death of Leach, to whom they had been intrusted.

1825. Desmarest, Anselme Gaetan. Considérations générales sur la Classe des Crustacés, et Description des Espèces de ces Animanx, qui vivant dans la mer, sur les côtes ou dans les eaux douces de la France. 8vo. Paris, Strasbourg, 1825, 447 pp. 5 tables, 56 plates.

A reprint of 1823 with many additions. Contained a useful history of the group, their structure, functions, habits, and economy, and a brief review of the classifications previously published, illustrated by five synoptic tables. First referred the Lernaeidae to the Crustacea, p. 343.

1763. Ellis, John, Esq. F. R. S. Of the Sea Pen or Pennatula phosphorea of Linnaeus; also a Description of a new species of Sea Pen, found on the Coast of So. Carolina, with Observations on Sea Pens in general. Philos. Trans., vol. 53, p. 419 seq., pl. 1.

Pennatula (*Pennella*) *filosa* and *P. sagitta*, p. 433.

1780. Fabricius, Otho. Fauna Groenlandica. 8vo., Hafniae et Lipsiae, 452 pp., 1 unn. plate.

All the species are placed under the one genus *Lernaea* and include *gadina*, p. 336; *cyclopterina* and *salmonea*, p. 337; *uncinata*, p. 338; *gobina*, p. 339; *radiata*, p. 340; *nodosa*, p. 341. The Latin descriptions are very accurate in their details but there are no figures.

1858. Flower, W. H. Exhibition of Penellus blainvilli, M. Edwds, on Flying-fish. Proc. Zool. Soc. London, vol. 26, p. 372.

1913. Fowler, Henry W. Notes on the fishes of the Chincoteague region of Virginia. Proc. Acad. Nat. Sci., Philadelphia, vol. 65, pt. 1, pp. 61–65.

"*Lerneaenicus radiatus*" found on *Brevoortia tyrannus*.

1913*b*. ————. The Crustacea of New Jersey. Report New Jersey State Mus. for 1911 (1913), pp. 29–650, pls. 1–150.

Lerneaenicus radiatus, p. 87, pl. 21. *Pennella filosa*, p. 90, pl. 22. *Pennella sagitta*, p. 91, pl. 23. *Lerneoceropsis septemramosus*, n. gen.; n. sp., p. 92, pl. 24; a synonym of *Lernaeenicus radiatus*. *Lerneocera* (*Lernaea*) *cruciata* and *L. tortua*, p. 477.

1876. Friederichsen, L. Kleine Mittheilungen aus dem Museum Godeffroy. Journ. Mus. Godeffroy, vol. 12, pp. 160–175.

Lernaeenicus abdominalis found upon *Boreogadus productus* Günther, on the Peruvian coast, p. 160.

1904. Gadd, Pehr. Parasit-Copepoder i Finland. Acta Soc. Fauna Flora Fennica, vol. 26, No. 8, 60 pp., 2 plates.

Lernaeocera (*Lernaea*) *esocina*, pp. 42–44.

1895. Garbini, A. Appunti di Carcinologia veronese. Mem. Accad. Verona, vol. 71, ser. 3, fasc. 1, 94 pp., 1 plate.

Lernaeocera (*Lernaea*) *esocina* and *L. cyprinacea*.

1560. Gesner, Conrad. Historia Animalium-De Aquatilibus. 5 vols. folio, Zurich.

Described *Pennella* and the Lernaeans, vol. 5, chap. 8, and gave the history of the parasites. The *Pennella* was seldom to be seen except at the time of the rising of the dogstar, and then not on many fishes, but only on the tunny, swordfish, and occasionally on the dolphin. He gave a text figure, p. 112, and repeated (p. 115) the figure given by Rondeletius.

1888. Giard, Alfred. Sur le Peroderma cylindricum (Heller), Copépode parasite de la Sardine. Compt. Rend. Acad. Paris, vol. 107, pp. 929–931. Also in Bull. Sci. de la France et le Belgique, ser. 3, vol. 2, pp. 312–314.

1889. ————. Sur l'association de Pennella orthagorisci Percival Wright, et de Conchoderma virgatum Spengler. Le Naturaliste (2), vol. 11, No. 50, p. 82.

The *Pennella* of *Balaenoptera rostrata* often shows specimens of *Conchoderma* attached to its thorax. Mayer had also seen them on *P. filosa* from the swordfish, and Giard added the finding of them on *P. orthagorisci*.

1790. GMELIN, JOHANN FRIEDRICH. Linnaeus Systema Naturae, Editio decima tertia, aucta, reformata, cura. Lipsiae, 1790.

All the parasitic copepods are bunched under the genus *Lernaea*, pp. 3144–3147.

1784. GOEZE, JOHANN A. E. Von der Fischlernaeen. Leipziger Mag. Naturk., 1784, pp. 39–49, pl. 1.

1879. GOODE, G. BROWN. The Natural and Economic History of the Menhaden. Rep. U. S. Comm. Fish. for 1877, pp. 1–529.

Mentioned (p. 104) one or more species of Lernaeans on the gills and *Lernaeenicus* upon the external surface, and figured the latter, pl. 10, fig. 15.

1883. ————. Materials for a History of the Sword-fish. Rep. U. S. Comm. Fish. for 1880, pp. 289–394.

Described, p. 346, *Pennella filosa* and *P. costaii* and three other parasitic copepods which infest this fish.

1870. HARTMANN, ROBERT. Beiträge zur anatomischen Kenntniss der Schmarotzer-Krebse. 2. Lernaeocera barnimii. Arch. Anat. Physiol., 1870, pp. 726–752, pls. 17, 18.

Detailed morphology of the female, considerable histology, and some of the larval development. *Lernaea barnimii.*

1871. ————. Ueber d. v. Poren durchsetzte Chitinskelet der Caliopus, Cecrops und gewisser Lernaeoceren. Sitzungsb. Gesell. Naturf. Freunde. Berlin (Oct. 1870), 1871, pp. 60–61.

1865. HELLER, DR. CAMIL. Reise der österreichischen Fregatte *Novara*. Zoologischer Theil, Zweiter Band. III Abtheilung. 1. Crustaceen, Wien, 4to, 280 pp., 25 plates.

Lernaeocera (*Lernaea*) *lagenula*, n. sp., p. 246, pl. 24, fig. 9. *Lernaeonema* (*Lernaeenicus*) *gracilis*, n. sp., p. 249, pl. 25, fig. 5. *Peroderma*, n. gen., p. 250. *Peroderma cylindricum*, n. sp., p. 250, pl. 25, fig. 6. *Lernaeolophus*, n. gen., p. 251. *Lernaeolophus sultanus*, n. sp., p. 251, pl. 25, fig. 7.

1783. HERMANN JEAN. Helmintologische Bemerkungen. Der Naturforscher (J. E. I. Walch), No. 19, pl. 2.

Described *Lernaea squamicola* and *L. lotae* (see p. 40).

1863. HESSE, EUGÈNE. Recherches sur quelques Crustacés rares ou nouveaux des Côtes de France. 2me Mémoire, De le Lernée branchiale et de celle qui vit sur le Gade barbu. Ann. Sci. Nat. (4), Zool., vol. 20, pp. 101–121, pl. 1.

1870. ————. Description d'une nouvelle espèce de Crustacé parasite de l'ordre des Lernéidiens de la famille des Lernéocériens, et du genre Lernée, Lernée du Gade-petit, Lernaea gadi minuti (nobis). Ann. Sci. Nat. (5), Zool., vol. 13, 30 pp., 1 plate.

A larval *L. branchialis.*

1891. ————. Description d'une nouvelle Lernée branchiale du Chaboisseau de Mer a longues Épines (Cottus bubalis, nobis). Ann. Sci. Nat. (7), Zool., vol. 11, pp. 187–195, pls. 6, 7.

Advocated a cirriped origin for *Lernaea* (*Lernaeocera*). Neither figures nor description locate the species with any satisfaction.

1904. HOFER, DR. BRUNO. Handbuch der Fischkrankheiten. 8vo. München. 359 pp., 222 text figures, 18 colored plates.

Parasitic copepods on the skin and gills, pp. 144–190.

1802. HOLTEN, H. S. Anmaerkninger till Beskrivelsen over Zeus guttatus samt Beskrivelser over tvende nye Arter Lernaeer. Skrivt. Naturh. Selsk., vol. 5, pt. 2, pp. 129–137, pl. 3.

Lernaea (*Chondracanthus*) *merluccii*, p. 135, pl. 3, fig. 2. *Lernaea* (*Pennella*) *exocoeti*, p. 136, pl. 3, fig. 3.

1878. Horst, Dr. R. Ueber zwei neue Schmarotzerkrebse. 1. Lernaeenicus gempyli, ein Schmarotzerkrebs von einem Fische (Gempylus serpens). 2. Ein Schmarotzerkrebs von eine Annelide (Polynoe rarispina). Tijdschr. Nederlandsche Dierk. Vereen. (Haag), Leyden, vol. 4, pp. 51–55, pl. 3, figs. 1–5.

L. gempyli here referred to the genus *Sarcotretes*.

1835. Johnston, George, M. D. Illustrations in British Zoology. Loudin's Mag. Nat. Hist., vol. 8, pp. 565–569, fig. 53, text.

Lernaea (*Clavella*) *uncinata*.

1888. Joubin, L. Note (contenue dans un pli cacheté) sur les ravages causés chez les Sardines par un Crustacé parasite. Compt. Rend. Acad. Paris, vol. 107, pp. 842–844.

Lernaeenicus, species.

1888*b*. ————. Sur un Copépode parasite des Sardines. Compt. Rend. Acad. Paris, vol. 107, pp. 1177–1178.

Lernaeenicus, species.

1911. Jungersen, Hector F. E. On a new Gymnoblastic Hydroid (Ichthyocodium sarcotretis) epizoic on a new parasitic Copepod (Sarcotretes scopeli) infesting Scopelus glacialis, Rhdt. Vid. Meddel. Naturh. Foren, Kjøbenhavn, vol. 64, pp. 1–33, pls. 1, 2, 6 text figures.

Gave the larval development of the copepod as well as the morphology of the adult female. Condensed reprint in Nature, London, vol. 88, No. 219h, p. 25.

1880. Kellicott, David S. Observations on Lernaeocera cruciata. Proc. Amer. Soc. Microscopists, vol. 1, pp. 64–68, pls. 1 and 2.

Lernaea cruciata.

1881. ————. Lernaeocera tortua, n. sp. Proc. Amer. Soc. Microscopists, vol. 2, pp. 41–43, 1 unn. plate.

Lernaea tortua.

1882. ————. On Certain Crustaceans Parasites of Fresh-water Fishes. Proc. Amer. Soc. Microscopists, vol. 4, pp 75–78.

Lernaeocera (*Lernaea*) *pectoralis* from axilla of redfin shiner, *Luxilus cornutus*.

1858. Kneeland, Dr. On the Parasites of a Sunfish. Proc. Boston Soc. Nat. Hist., vol. 6, p. 396.

A species of "*Lernaea*" (*Pennella ?*) was attached in large numbers around the dorsal and anal fins.

1860. Koch, C. L. Collezio Adriatico del Museo di Storia naturale di Trieste. Trieste, 1860.

Lernaeolophus sultanus.

1775. Koelreuter, Jos. Gli. Lernaeae forsan adhuc incognitae Gadi callarii L. branchiis firmiter inhaerentis descriptio. Comment. Acad. Theod. Palat., vol. 3, Phys., pp. 57–61.

Probably *Lernaeocera branchialis*.

1877. Koren, J. and Danielssen, D. C. A new Species of the Genus Pennella, Pennella balaenopterae, nobis. Fauna Littoralis Norvegiae, pt. 3, pp. 157–163, pl. 16, figs. 1–9.

An excellent description and figures showing the internal as well as the external morphology.

1835–8. KRØYER, HENRIK. Om Snyltekrebsene, isaer med Hensyn til den Danske Fauna. Naturh. Tidsskr., vol. 1, pt. 2, 1835, pp. 172–208, pl. 2; pt. 3, 1835, pp. 252–304, pl. 3; pt. 5, 1837, pp. 476–504, pl. 5; pt. 6, 1837, pp. 605–628, pl. 6; vol. 2, pt. 1, 1838, pp. 8–52, pl. 1; pp. 131–157, pl. 3.

A review of the entire group giving its distinguishing characters and a systematic synopsis based upon that of Burmeister (1833), dividing the group into five classes, the first of which was the Penellina, including the genera *Lernaea, Lernaeocera, Peniculus, Pennella,* and *Sphyrion.* The only species described belonging to this class were *Lernaea* (*Lernaeocera*) *branchialis,* p. 293, pl. 3, fig. 10, and *Lernaea* (*Haemobaphes*) *cyclopterina,* p. 502, pl. 5, fig. 4.

1863. ————. Bidrag til Kundskab om Snyltekrebsene. Naturh. Tidssk. (3), vol. 2, pp. 75–426, pls. 1–18.

Also as a reprint with pages numbered 1–352. The following references are to the latter. *Therodamas serrani,* n. gen.; n. sp., p. 316, pl. 15, fig. 4. *Lernaea* (*Lernaeolophus*) *hemiramphi,* n. sp., p. 318, pl. 15, fig. 7. *Lernaea* (*Lernaeocera*) *rigida,* n. sp., p. 320, pl. 18, fig. 2. *Lernaeocera* (*Lernaea*) *catostomi,* n. sp., p. 321, pl. 18, fig. 4. *Lernaeocera* (*Lernaea*) *pomotidis,* n. sp., p. 323, pl. 15, fig. 5. *Lernaeocera* (*Lernaea*) *phoxinacea,* p. 325, pl. 18, fig. 3. *Pegesimallus spiralis,* n. gen.; n. sp., p. 332, pl. 18, fig. 7. *Peniculus clavatus,* p. 266, pl. 14, fig. 8.

1801. LAMARCK DE, JEAN B. P. Système des Animaux sans vertèbres. 1 vol. 8vo. Paris, An IX (1801).

Placed the Lernaeidae among the mollusks.

1809. ————. Philosophie-Zoologie. 8vo. Paris.

Removed the Lernaeidae from the mollusks and placed them with the annelids.

1812. ————. Extrait du Cours de Zoologie sur les Animaux sans Vertèbres. 8vo. Paris.

Formed a separate class to receive the Lernaeans which he named the "Epizoaires".

1816. ————. Historie Naturelle des Animaux sans Vertèbres. 7 vols. 8vo. Paris. Another edition, 1838.

Placed the Lernaeans with the "Epizoaria" and said "These animals approach near to the worms and insects without belonging to either".

1798. LAMARTINIÈRE. Atlas du Voyage de *La Peyrouse.*

Gave a figure, pl. 20, fig. 6, of *Pennatula bocconii,* probably *Pennella sagitta.*

1889. LEIDY, JOSEPH. Parasitic Crustacea. Proc. Acad. Nat. Sci., Philadelphia, 1888, p. 165.

Described *Lerneonema* (*Lernaeenicus*) *procera,* n. sp., attached to the sides of the mouth and upper lip of "*Odontaspis littoralis,*" and thickly covered with a hydroid parasite.

1890. ————. Parasites of Mola rotunda. Proc. Acad. Nat. Sci., Philadelphia, 1890, pp. 281–282.

Pennella filosa mentioned and described.

1824. LE SUEUR, C. A. On three new species of Parasitic Vermes belonging to the Linnaean Genus Lernaea. Journ. Acad. Nat. Sci., Philadelphia, vol. 3, pp. 286–293, pl. 11, fig. 1–4.

Lerneocera cruciata, n. sp., p. 286, pl. 11, fig. 4; *Lerneocera radiata,* n. sp., p. 288, pl. 11, fig. 1. "*Lerneaenicus,*" n. gen., p. 289. *Lerneopenna blainvillii,* n. sp., p. 289, pl. 11, figs. 2 and 3 (see p. 115).

1825. ————. Sur trois nouvelles espèces du genre Lernaea. Féruss. Bull. Sci. Nat., vol. 4, pp. 285–286. French translation of 1824 paper.

1746. LINNAEUS, CAROLUS. Fauna Suecica Sistens Animalia Suecica Regni. Ed. 1, 1 vol. 8vo. Stockholm. Ed. 2, 1 vol. Stockholm, 1761.

Described a parasite found upon *Cyprinus carassius,* and established from this species the genus *Lernaea.*

1758. LINNAEUS, CAROLUS. Systema Naturae. Tenth Edition, 8vo., Stockholm.

The genus *Lernaea* contained here three species, *cyprinacea*, the original type, *asellina*, afterward made the type of the genus *Oralien*, and *salmonea*, which now belongs to the genus *Salmincola* (p. 655). Genus *Pennatula* (p. 818) changed to *Pennella* by Oken in 1815. *P. filosa* and *P. sagitta*, p. 819.

1893. LISTOWSKY, E. Penella tridentata, neuer Art der parasitirenden Crustaceen. Tradui Kazan. Univ., vol. 25, pt. 2, 19 pp., 1 unn. plate.

Russian prefaced by a three-line Latin diagnosis.

1860. LUBBOCK, SIR JOHN. On some Oceanic Entomostraca collected by Captain Toynbee. Trans. Linnaean Soc., vol. 23, p. 190, pl. 29, figs. 40 and 42.

Baculus elongatus, n. gen.; n. sp., which was afterward proved to be a larval stage of *Pennella* species (compare Mrazek, 1895, and Thompson, 1890.)

1893. LÜTKEN, CHRISTIAN. Slaegten Baculus Lubbock et udviklingstrin af Penella. Vidensk. Meddel. Naturh. For. Kjøbenhavn (5), vol. 15, pp. 73–76.

Shows that Lubbock's *Baculus* is an undeveloped *Pennella* species.

1879. MAYER, PAUL. Carcinologische Mittheilungen. V. Pennella und Conchoderma. Mitth. Zool. Stat. Naples, vol. 1, p. 53.

Pennella filosa from a swordfish and infested with a goose barnacle.

1868. METZGER, A. Ueber das Männchen und Weibchen der Gattung Lernaea vor den Eintritt der sogen. ruckschreitenden Metamorphose. Arch. Naturg., vol. 34, pp. 106–110.

Translated in Ann. Mag. Nat. Hist., ser 4, vol. 3, pp. 154–157, 1869.

1840. MILNE EDWARDS, HENRI. Histoire Naturelle des Crustacés. 3 vols. 8vo. Paris.

A standard work containing a summary of everything previously published and much new material. The Lernaeans, pp. 521–529, pls. 40, 41. *Lerneonema*, n. gen., p. 524, the same as LeSueur's *Lernaeenicus*.

1881. MOREAU, EMILE. Histoire Naturelle des Poissons de la France. Paris, 3 vols.

Mentioned, vol. 3, p. 460, *Lernaeenicus sprattae* fastened to the eye of a spratt.

1895. MRÁZEK, AL. Ueber Baculus Lub. und Hessella Br. Ein Beitrag zur Anatomie der Lernaeiden. Sitzungsb. königl. böhmischen Ges. Wiss., Math.-Naturw. Classe, vol. 44, 17 pp., pls. 1, 2.

Both of these so-called new genera are really development stages of a *Pennella* species. The description of *Baculus* includes the internal anatomy as shown in serial sections.

1776. MÜLLER, OTHO F. Zoologiae Danicae Prodromus. 1 vol. 8vo. Copenhagen.

Afterwards published in full in four volumes, German and Latin, from 1779 to 1784. The Lernaeans were placed with the worms and mollusks.

1682. MURALTUS. Miscellania curiosa sive Ephemeridum Medico Physicarum Germanicarum Academiae Naturae Curiosum. 8vo. Nuremberg.

While dissecting *Mustela fluviatilis* he found "an insect" inserted into the eye of the fish and hanging out from it. It was so firmly fixed by its arms that no doubt it caused the humours of the eye to escape and rendered the fish blind (p. 126). Probably *Trypaphylum mustelli*.

1856. MURRAY, ANDREW. Description of a new species of Echeneis (E. tropicus) and of a new Lernean of the genus Penella (P. remorae), infesting the Echeneis remora; with some remarks on the economy of the Remora. Edinburgh New Philos. Jour., n. s., vol. 4, pp. 287–301, 5 text figures.

This *P. remorae* is almost certainly the young of some described species.

1878. NARES. Narrative of a voyage to the Polar Sea during 1875–76 in H. M. Ships *Alert* and *Discovery*. 2 vols. London.

Haemobaphes cyclopterina, vol. 2, p. 247.

1832. NORDMANN, ALEX VON. Erster Beitrag zur Naturgeschichte der Lernäen. Mikrogr. Beitr. Naturg. wirbel. Thiere, pt. 2, pp. 49–144, pls. 1–10.

Peniculus fistula, n. gen., n. sp., p. 107, pl. 6, figs. 8–13. *Pennella sagitta*, p. 121, pl. 10, figs. 6–8. *Lernaeocera* (*Lernaea*) *cyprinacea*, p. 123, pl. 6, figs. 1–7. *Lernaeocera branchialis*, p. 130.

1864. ———. Neue Beiträge zur Kenntniss parasitischer Copepoder. Erster Beitrag. Bull. Soc. Imp. Nat. Moscou, vol. 37, No. 4, pp. 461–520, pls. 5–8.

Begins with a bibliography of the subject and then gives a classification of the known genera. *Pennella sultana* with var. *sigmoidea*, p. 485, pl. 5, figs. 12–16. *Peniculus fistula* and *P. calamus*, n. sp., p. 515.

1759. ODHELIUS, J. L. Chinensia lagerstromiana. Amoen. Acad. (of Linnaeus), vol. 4, p. 257, fig. 3, text.

A description of *Pennella sagitta*.

1816. OKEN, L. Lehrbuch der Naturgeschichte. Dritter Theil, Zoologie. 2 vols. 8vo. Jena, with Atlas.

Parasitic Copepods, vol. 2, pp. 181, 357.

1821. OKEN, CHAMISSO, and EYSENHARDT. Ueber Pennella diodontis. Nova Acta Acad. Caes. Leopold. Bonn, vol. 10, p. 350, pl. 24, fig. 3. Also published in Actes nouv. Acad. Curieux Nature, vol. 10, pt. 2, pl. 24, fig. 2.

120 A. D. OPPIANUS. Ἁλιευτικά, On Fishing.

Repeated Aristotle's description of the sufferings of the tunny and swordfish and declared that the fish are frequently killed by these parasites, liber 11, p. 24.

1867. PACKARD, ALPHEUS S., Jr. Observations on the Glacial Phenomena of Labrador and Maine, with a View of the Recent Invertebrate Fauna of Labrador. Mem. Boston Soc. Nat. Hist., vol. 1, pp. 295–303, pl. 8.

Lernaea (*Lernaeocera*) *branchialis*, var. *sigmoidea* mentioned (p. 295) as found attached to the skin of a codfish (see S. I. Smith, 1884).

1875. ———. Life-histories of the Crustacea and Insects. Amer. Naturalist, vol. 9, pp. 583–622, text figures.

A restatement of E. van Beneden's 1870 paper, including development of *Lernaeenicus radiatus*.

1905. PEARSON, JOSEPH. A List of the Marine Copepoda of Ireland. Part 1, Littoral Forms and Fish Parasites. Rep. Fisheries Ireland for 1904, pt. 2, No. 3, 30 pp.

A simple list without descriptions or figures.

1893. PEDASCHENKO, D. D. Sur la segmentation de l'œuf et la formation des feuillets embryonnaires chez la Lernaea branchialis L. Note préliminaire. Revue Sci. Nat. St.-Pétersbourg, vol. 4, pp. 187–199, 11 text figures.

Lernaeocera branchialis.

1897. ———. Ueber die Entwickelung des Nervensystems und der Genitalzellen und die Dorsalorgane von Lernaea branchialis. Arbeit. Nat. Ges. Petersburg, vol. 37, 11 pp. Condensed and reprinted in Trav. Soc. Impér. Nat. St.-Pétersbourg, vol. 27, No. 6, pp. 187–194.

Lernaeocera branchialis.

1898. Pedaschenko, D. D. Die Embryonalentwickelung und Metamorphose von Lernaea branchialis. Trav. Soc. Impér. Nat. St.-Pétersbourg, vol. 26, pt. 4, No. 7, Section Zool. et Physiol. Russian text, pp. 1–246; German text, pp. 247–307, pls. 1–6.

Includes segmentation of the egg and the development of both the external body form and the internal organs. *Lernaeocera branchialis.*

78 A. D. Plinius Secundus, Caius. Historia Naturalis. 37 Books.

Repeated, Book 9, Section 16, what Aristotle had said with reference to the sufferings of the tunny and swordfish from the parasites infesting them.

1910. Quidor, Auguste. Note préliminaire sur Penella balaenopterae Koren et Danielssen. Bull. Mus. Hist. Nat., Paris, 1910, pp. 97–98.

A mutilated specimen identified by mode of insertion and branching of abdominal appendages.

1912. ————. Affinités des genres Sphyrion (Cuvier) et Hepatophilus (g. n.). Arch. Zool., Paris, (5), vol. 10, pp. xxxix–l, 6 text figures.

Advocates a transfer of the genus *Sphyrion* from the Chondracanthidae to the Lernaeidae and places with it the new genus.

1912*b*. ————. Deuxième Expédition Antarctique Française (1908–1910). Copépodes Parasites. Sciences Naturelles: Documents Scientifiques, pp. 197–214, pls. 1–4.

Penella antarctica, n. sp., p. 206, pl. 1, figs. 15–17; pl. 4, fig. 29, 34. *Penella charcoti,* n. sp., p. 207, pl. 1, fig. 13; pl. 2, fig. 25; pl. 4, fig. 33. *Penella liouvillei,* n. sp., p. 209, pl. 1, fig. 1. *Penella diodontis,* pl. 1, fig. 2. *Penella exocoeti,* pl. 1, fig. 3. *Penella sagitta,* pl. 1, fig. 4. *Penella anthonyi,* n. sp., pl. 1, fig. 9. *Penella cettei,* n. sp., pl. 1, figs. 11, 12. *Penella balaenopterae,* pl. 1, fig. 14. *Lernaea (Lernaeocera) godfroyi,* n. sp., p. 210, pl. 2, fig. 23.

1912*c*. ————. Sur la torsion des Lernaeidae et les affinités du genre Sphyrion (Cuvier) et Hepatophylus (n. g.). Compt. Rend. Acad. Paris, vol. 154, pp. 87–89.

The torsion is the result of the mode of fixation, the habits of the host, and the mechanical action of the external medium. It plays an important rôle in systematization as it enables us to distinguish the Chondracanthidae from the Lernaeidae, and to transfer the genus *Sphyrion* from the former to the latter. (See p. 10.)

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Lernaea (Lernaeocera) branchialis, p. 129.

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Lernaeenicus vorax, n. sp., p. 203, pl. 7, figs. 1–21. *L. neglectus*, n. sp., p. 206, pl. 7, figs. 23–43.

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Lernaeonema and *Lernaeenicus*, p. 398. *Lernaeenicus nodicornis*, n. sp. and *L. inflexus*, n. sp., p. 401, pl. 13, figs. 26 and 27; both are here referred to Jungersen's genus *Sarcotretes*. *Lernaea (Lernaeocera) branchialis, var. sigmoida*, new, p. 404, pl. 13, fig. 29. *Haemobaphes*, n. gen., p. 405; *H. cyclopterina*, type species, pl. 13, fig. 30. *Pennella sagitta*, p. 409, pl. 14, fig. 31. *P. varians*, n. sp., p. 413, pl. 14, fig. 32. *P. exocoeti*, p. 415, pl. 14, fig. 33. *P. crassicornis*, n. sp., p. 416, pl. 14, fig. 34.

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Haemobaphes cyclopterina, p. 458. *Lernaeenicus* (*Cardiodectes*) *medusaeus*, n. sp., p. 458, pl. 76, figs. 99, 100. *Phrixocephalus cincinnatus*, n. gen.; n. sp., p. 461, pl. 76, fig. 101.

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Pennella orthagoriscí.

EXPLANATION OF THE PLATES.

an^1	first antennae.
an^2	second antennae.
ba	bulbus arteriosus.
cb	chitin band.
cg	cement gland.
ch	chitinogen layer.
cr	chitin ring.
dg	digestive gland.
e	eye.
eg	excretory gland.
fp	frontal processes.
ig	infra esophageal ganglion.
in	intestine.
l^1	first swimming legs.
l^2	second swimming legs.
l^3	third swimming legs.
l^4	fourth swimming legs.
lb	labium.
lm	labrum.
m	soft membrane.
md	mandible.
mo	mouth.
ms	muscle.
mx^1	first maxilla.
mx^2	second maxilla.
mxp	maxilliped.
od	oviduct.
oe	esophagus.
ov	ovary.
p	posterior prolongation of esophagus.
pb	proboscis.
pc	pore canal.
rc	rectum.
sg	supra esophageal ganglion.
sr	semen receptacle.
st	stomach.

PLATE 1.

Female of *Peniculus clavatus.*

Fig. 1. Side view; actual length of egg strings 17 mm. Fig. 2. Head and neck, enlarged, showing antennae, mouth-parts, and musculature of proboscis. Fig. 3. First and second antennae, ventral view. Figs. 4, 5. First and second swimming legs. Fig. 6. Anal laminae. Fig. 7. Ventral view of cleared specimen, showing arrangement of reproductive organs.

PLATE 2.

Female of *Peniculus fissipes.*

Fig. 8. Side view; actual length of egg strings 10.50 mm. Fig. 9. Head and anterior thorax much enlarged. Figs. 10, 11, 12. First, second, third, and fourth swimming legs. Fig. 13. Anal laminae. Fig. 14. Side view of cleared specimen, showing arrangement of reproductive organs.

PLATE 3.

Female of *Cardiodectes medusaeus.*

Fig. 15. Side view of cleared specimen, showing reproductive and digestive systems; frontal processes removed from head. Fig. 16. Side view of head and anterior thorax, with processes in place. Fig. 17. First and second antennae and

rostrum, dorsal view. Fig. 18. Dorsal view of head, processes removed except those on the sides. Fig. 19. Ventral view of head, showing the peculiar entrance of the esophagus into the side of the stomach. Fig. 20. Proboscis enlarged. Fig. 21. Section of body wall, showing pore canal and chitinogen layer. Fig. 22. First three pairs of swimming legs. Fig. 23. Ventral view of cleared specimen, showing reproductive organs.

PLATE 4.

Female of *Lernaeenicus radiatus*.

Fig. 24. Side view, drawn by J. H. Blake. Fig. 25. Posterior view of head, also drawn by J. H. Blake. Fig. 26. Side view, drawn by R. Rathbun. Fig. 27. Top view of head. Fig. 28. Side view of head, showing proboscis and posterior plate at base of antennae. Fig. 29. Dorsal view of head with only two horns. Fig. 30. Diagonal view of same cut open to show the digestive tube. Fig. 31. Side view of proboscis. Fig. 32. Tip of proboscis, showing central plate and maxillae. Fig. 33. Maxilla. Fig. 34. First and second antennae and rostrum. Fig. 35. Side view of posterior trunk with egg strings; figs. 27 to 35 drawn by R. Rathbun.

PLATE 5.

Females of *Lernaeenicus radiatus* and *L. polyceraus*.

Figs. 36 to 39. Swimming legs of *L. radiatus*. Fig. 40. Head and neck, with two sets of horns. Fig. 41. Ventral view of maxilla. Fig. 42. Side view of *L. polyceraus*. Fig. 43. Ventral view of head and neck. Fig. 44. Side view of head. Fig. 45. Attachment lamellae. Fig. 46. Tip of proboscis with maxillae. Fig. 47. Swimming legs.

PLATE 6.

Female of *Lernaeenicus affixus*.

Fig. 48. Side view. Fig. 49. Side view of head fastened to the ray of a fin. Fig. 50. Side view of head with attachment apparatus. Fig. 51. Anterior view of attachment lamellae. Fig. 52. First antenna. Fig. 53. Second antenna. Fig. 54. Tip of proboscis. Fig. 55. Mandibles. Fig. 56. Maxilla. Fig. 57. Anal laminae. Figs. 58 to 61. Swimming legs.

PLATE 7.

Female of *Lernaeenicus longiventris*.

Fig 62. Side view. Fig. 63. Side view of head. Fig. 64. First and second antennae. Fig. 65. The same on another specimen. Fig. 66. Mandibles. Fig. 67. Maxilla. Fig. 68. Swimming legs. Fig. 69. Longitudinal section of head and anterior neck. Fig. 70. Newly hatched nauplius.

PLATE 8.

Female of *Sarcotretes lobatus*.

Fig. 71. Diagonal view, partly dorsal, partly lateral. Fig. 72. Dorsal view of head. Fig. 73. Tip of proboscis, dorsal. Fig. 74. Tip of proboscis, ventral. Fig. 75. First and second antennae. Fig. 76. Maxilla. Fig. 77. Swimming legs. Fig. 78. Lateral view of cleared specimen, showing reproductive organs. Fig. 79. Ventral row of excretory glands.

PLATE 9.

Female of *Phrixocephalus triangulus*.

Fig. 80. Dorsal view of head and neck, side view of trunk. Fig. 81. Ventral view of head and neck with swimming legs. Fig. 82. Diagonal view of head, showing antennae. Fig. 83. Anterior view of head with processes. Fig. 84. Lateral view of cleared specimen, showing reproductive organs.

PLATE 10.

Phrixocephalus triangulus, *P. diversus*, and *Lernaeocera branchialis*.

Fig. 85. Ventral view of cleared specimen of *P. triangulus*, showing bilateral symmetry. Fig. 86. Diagonal view of *P. diversus*. Fig. 87. Side view of same, showing asymmetrical position of neck. Fig. 88. Metanauplius of *Lernaeocera branchialis;* actual length, 0.55 mm.

PLATE 11.

Female of *Collipravus parvus*.

Fig. 89. Ventral view of head, side view of body. Fig. 90. Side of head (*a*). Fig. 91. Dorsal view of same. Fig. 92. Ventral view of head (*b*). Fig. 93. Dorsal view of same. Fig. 94. Dorsal view of second antennae. Fig. 95. Proboscis and maxillae. Figs. 96, 97. Dorsal and ventral view of cleared specimen, showing asymmetrical arrangement of reproductive organs.

PLATE 12.

Female and nauplius of *Lernaeocera branchialis*.

Fig. 98. Side view. Fig. 99. Central view of head. Fig. 100. Anterior view of head; these three figures drawn by J. H. Blake. Fig. 101. Side view of head with proboscis protruded. Fig. 102. First and second antennae. Fig. 103. Mouth tube and first maxillae. Fig. 104. Second maxilla. Fig. 105. Swimming legs. Fig. 106. Anal laminae. Fig. 107. Newly hatched nauplius; actual length, 0.45 mm.

PLATE 13.

Female of *Lernaeolophus sultanus*.

Fig. 108. Side view. Fig. 109. First and second antennae. Figs. 110, 111. Swimming legs. Fig. 112. One of the abdominal plumules. Fig. 113. Side view of cleared specimen, showing digestive tube and reproductive organs.

PLATE 14.

Female of *Haemobaphes cyclopterina*.

Fig. 114. Side view of trunk, dorsal view of posterior neck, ventral view of anterior neck and head. Fig. 115. Dorsal view of cephalothorax. Fig. 116. Ventral view of same. Fig. 117. Ventral view of anterior head. Fig. 118. Side view of cleared specimen showing reproductive organs.

PLATE 15.

Females of *Pennella antarctica* and *P. filosa*.

Fig. 119. Side view of *P. antarctica*. Fig. 120. Pieces of whale blubber with parasites in place; the piece on the right shows the scar left after the disappearance of the parasite; photograph by Dr. Roy C. Andrews. Fig. 121.

Dorsal view of first and second antennae. Fig. 122. Ventral view of head, showing frontal processes. Fig. 123. Inner surface of ventral wall of head. Fig. 124. Swimming legs. Fig. 125, Side view of *P. filosa*, drawn by J. H. Blake. Fig. 126. Anterior view of head. Fig. 127. Dorsal view of same, both drawn by J. H. Blake.

PLATE 16.

Female of *Pennella filosa.*

Figs. 128, 129. Dorsal and ventral views of head, with frontal processes and internal muscles. Figs. 130, 131. External and internal views of anterior end of head with frontal processes removed. Fig. 132. Dorsal view of first and second antennae. Fig. 133. Side view of cleared specimen, showing reproductive organs.

PLATE 17.

Females of *Pennella filosa* and *Lernaeocera branchialis.*

Fig. 134. Swimming legs of adult *P. filosa.* Fig. 135. Side view of head of young female of *P. filosa*, 18 mm. long. Fig. 136. Second maxilla. Fig. 137. Diagonal view of thorax, with swimming legs. Fig. 138. Posterior end of genital segment, showing enlargement in oviduct which serves as a receptaculum seminis. Fig. 139. Posterior end of abdomen, with anal laminae. Fig. 140. Side veiw of cleared specimen of *Lernaeocera branchialis*, showing digestive tube and reproductive organs (after A. Scott).

PLATE 18.

Female of *Pennella instructa.*

Fig. 141. Side view, drawn by J. H. Blake. Fig. 142. Ventral view of head and anterior neck. Fig. 143. Anterior end of head, internal view. Fig. 144. Anterior end of head, external view showing frontal processes. Fig. 145. Dorsal view of first and second antennae. Fig. 146. Swimming legs. Fig. 147. A specimen of *P. instructa* infested with goose barnacles.

PLATE 19.

Female of *Haemobaphes diceraus.*

Fig. 148. Side view of adult with egg strings. Fig. 149. Ventral view of head and anterior thorax, cleared in clove oil. Fig. 150. Dorsal view of head and anterior thorax, showing single pair of horns. Fig. 151. Ventral view of proboscis.

PLATE 20.

Haemobaphes diceraus, H. enodis, and *Trifur tortuosus.*

Fig. 152. First and second antennae of *H. diceraus.* Fig. 153. First and second swimming legs. Figs. 154, 155. Third and fourth swimming legs. Fig. 156. Side view of adult *H. enodis*, with egg strings. Fig. 157. Ventral view of head and anterior thorax, showing the profusion of soft processes. Fig. 158. Side view of cleared specimen of *T. tortuosus*, showing the arrangement of the internal organs.

PLATE 21.

Females of *Trifur tortuosus* and *Cardiodectes bellottii.*

Figs. 159 and 160. Side view of head and anterior thorax, and of trunk of *T. tortuosus.* This is drawn from an entire specimen but the long neck is so twisted in different directions that it does not give a satisfactory view of the entire creature in any one position. Fig. 161. Side view of *C. bellottii*, showing the lobed frontal processes. Fig. 162. Side view of head and anterior thorax, showing the four pairs of legs; the thoracic process on the side nearest the observer has been removed.

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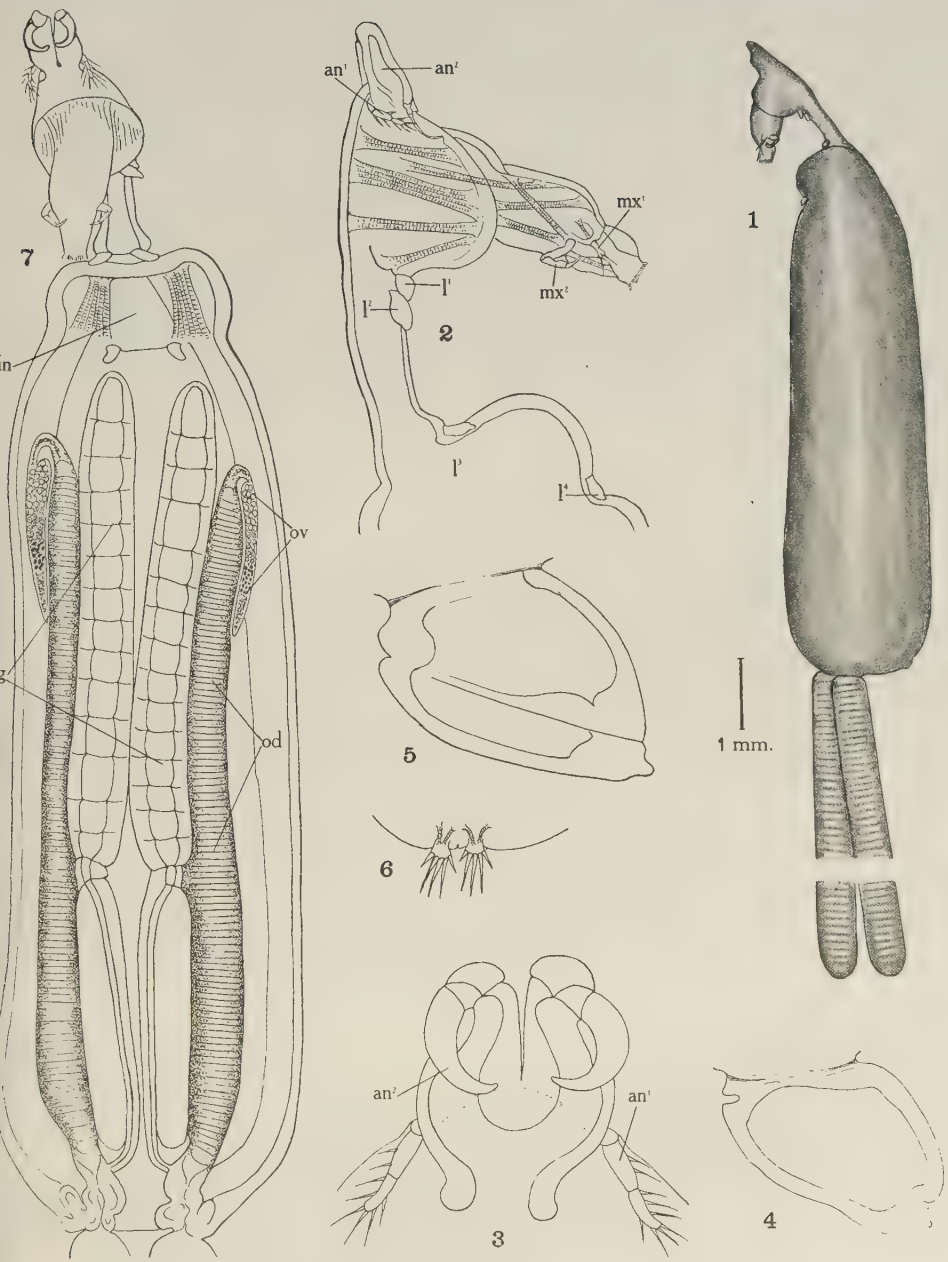

FEMALE OF PENICULUS CLAVATUS.

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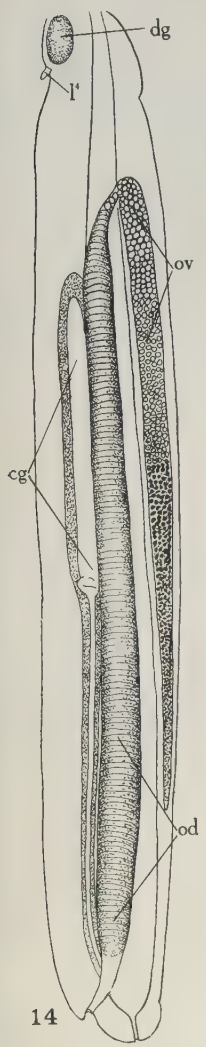

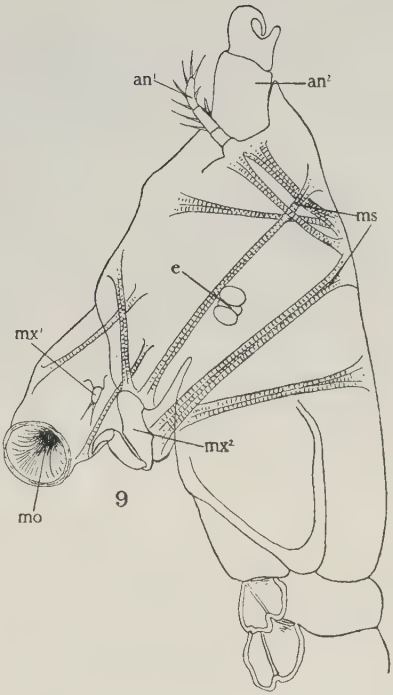

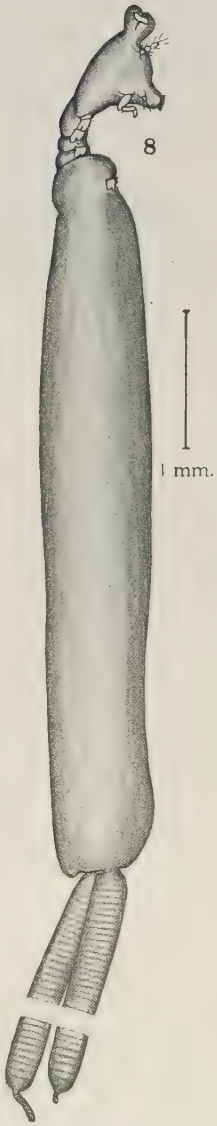

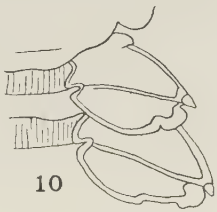

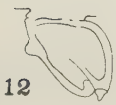

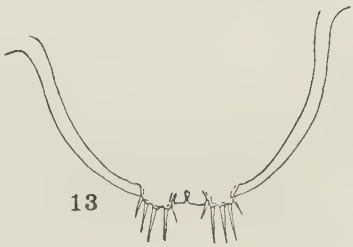

FEMALE OF PENICULUS FISSIPES.

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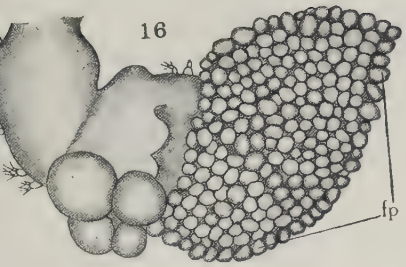

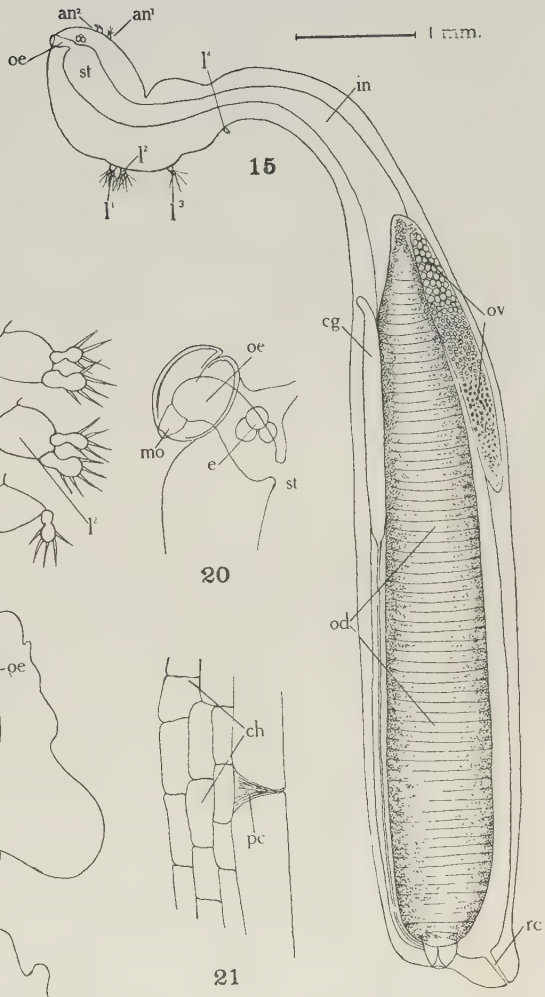

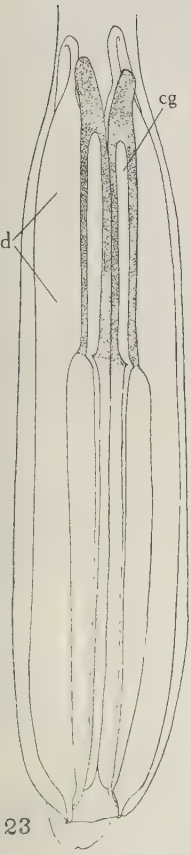

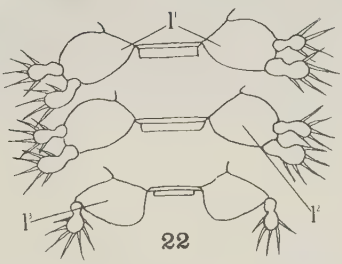

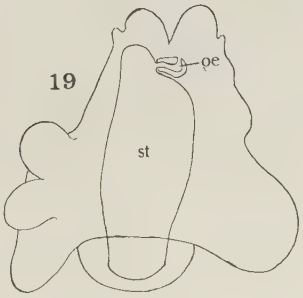

FEMALE OF CARDIODECTES MEDUSAEUS.

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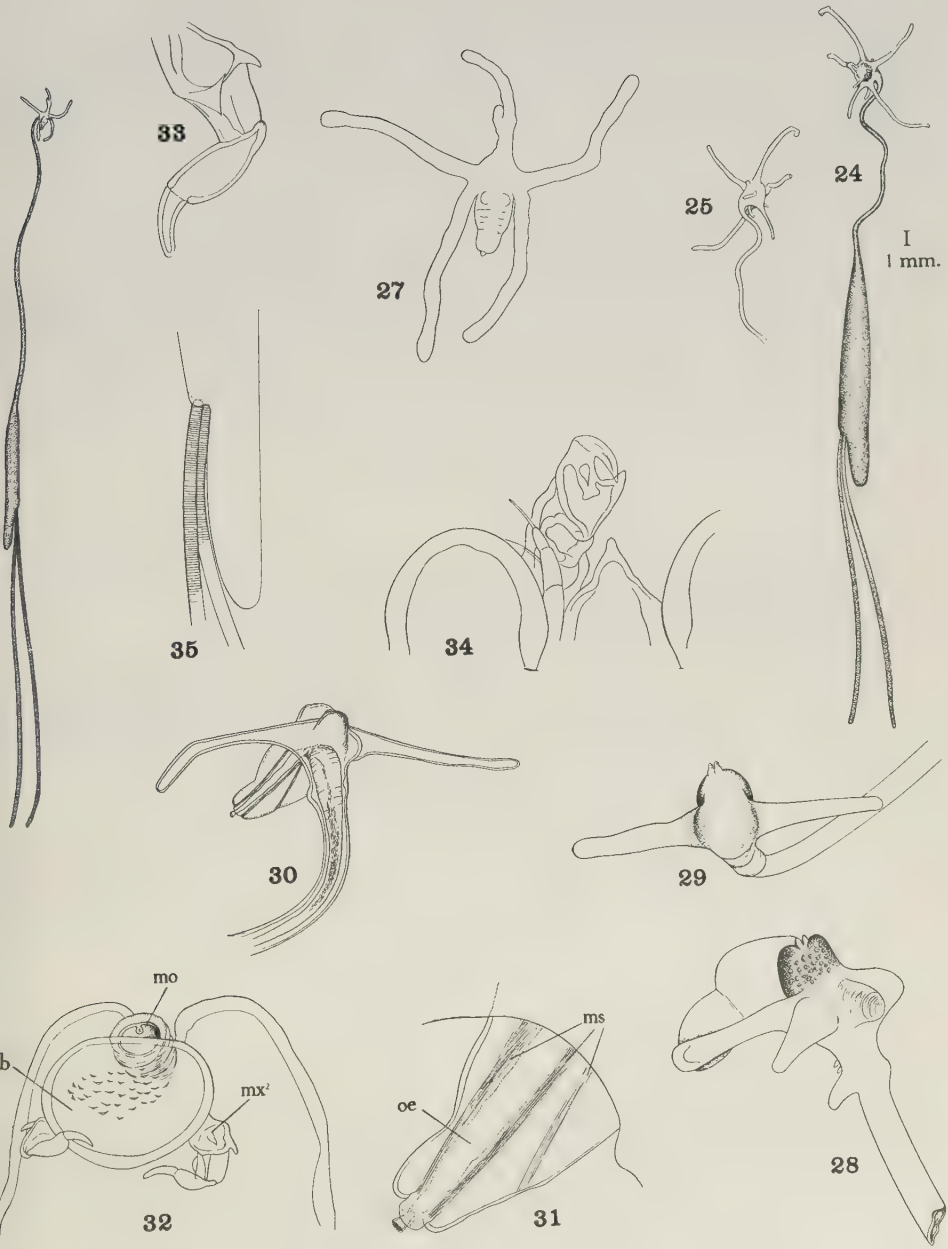

FEMALE OF LERNAEENICUS RADIATUS.

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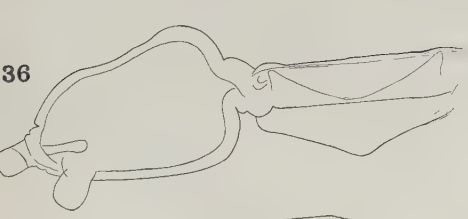
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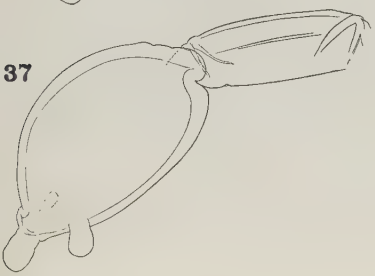
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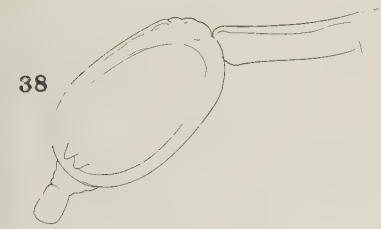
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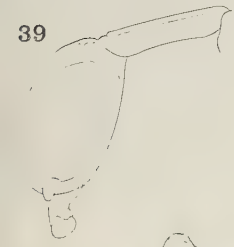
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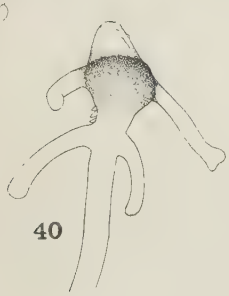
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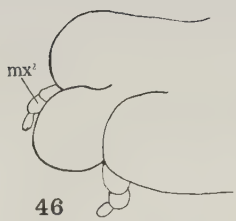

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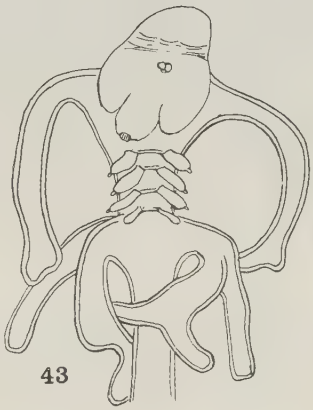
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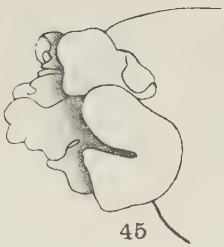
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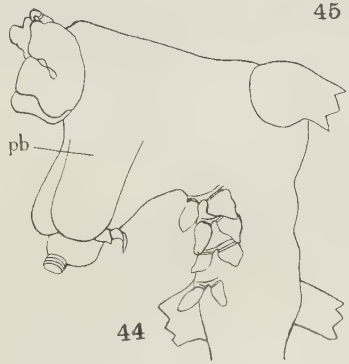

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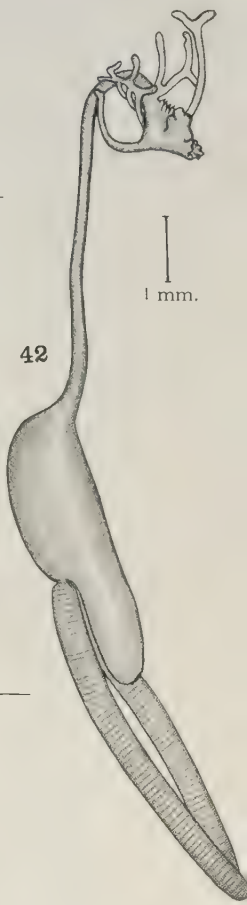

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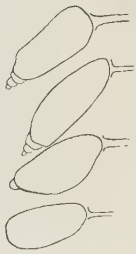
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FEMALES OF LERNAEENICUS RADIATUS AND L. POLYCERAUS.

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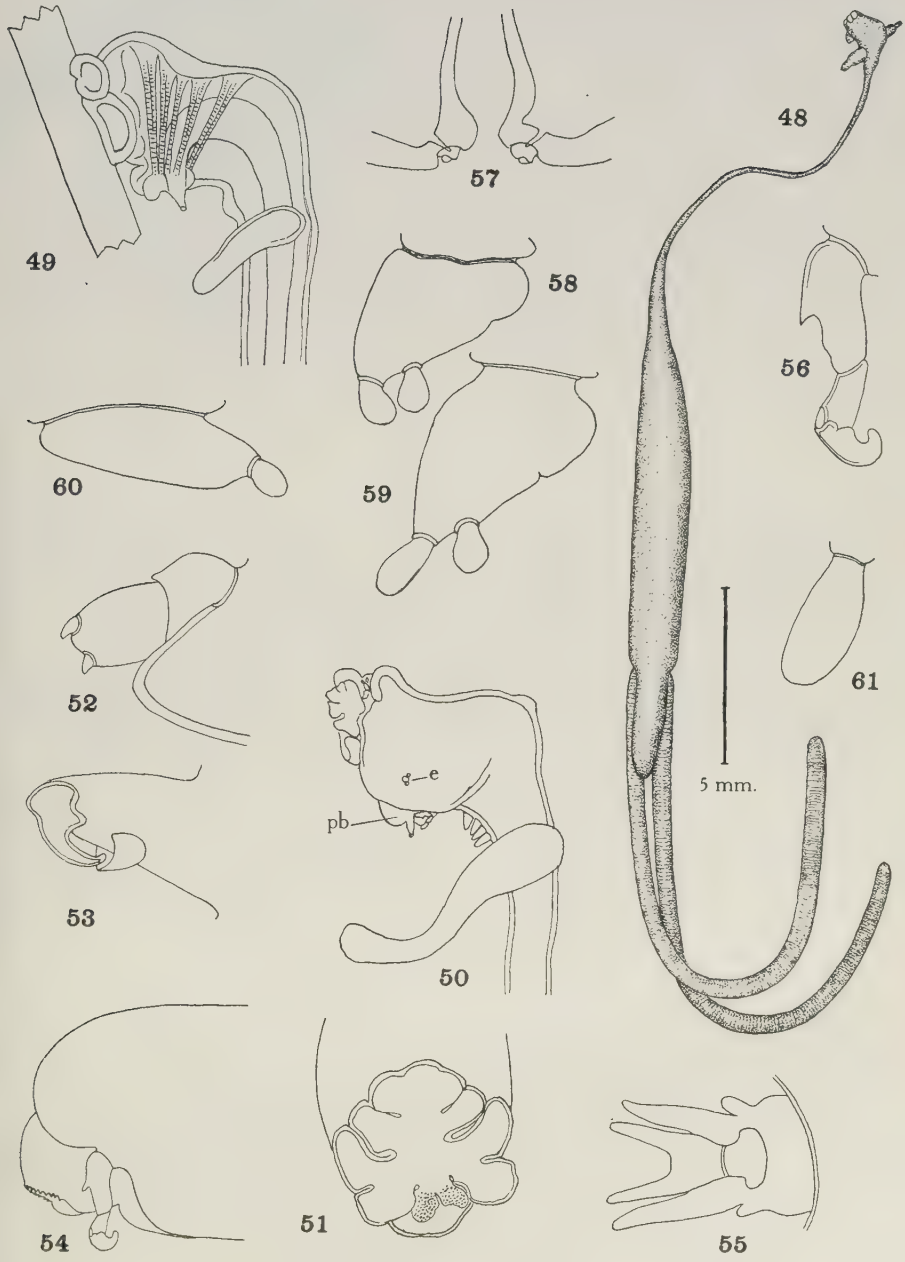

FEMALE OF LERNAEENICUS AFFIXUS.

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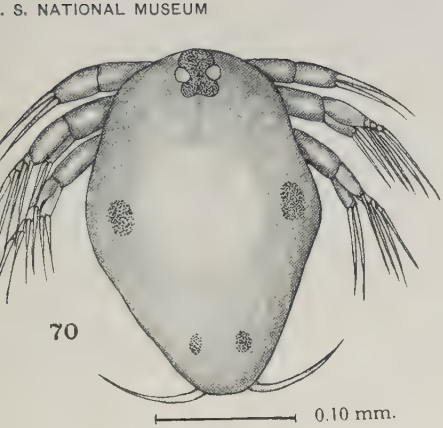

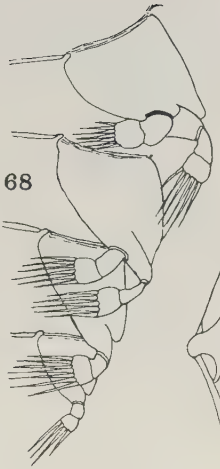

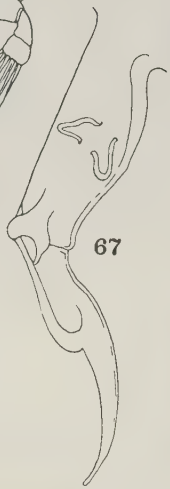

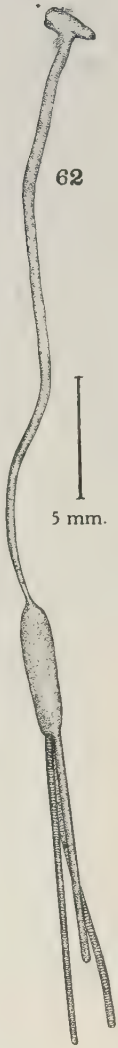

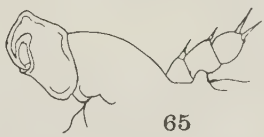

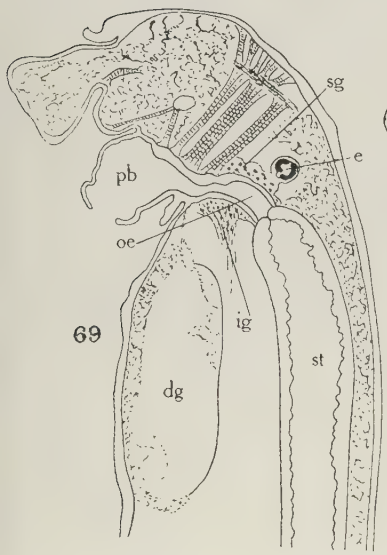

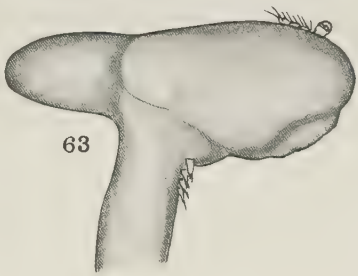

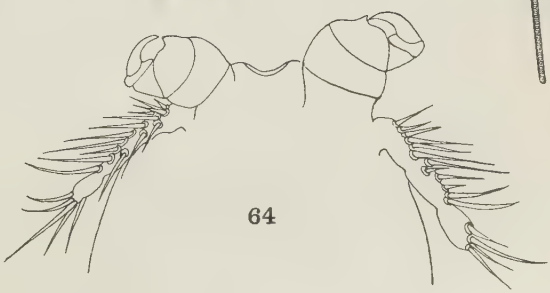

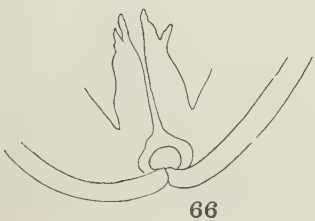

FEMALE OF LERNAEENICUS LONGIVENTRIS.

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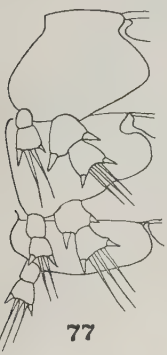
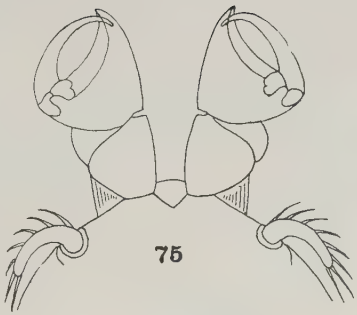
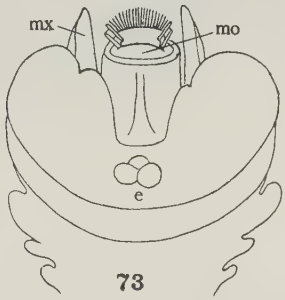
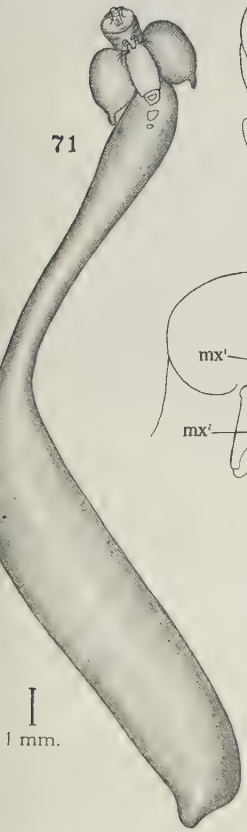
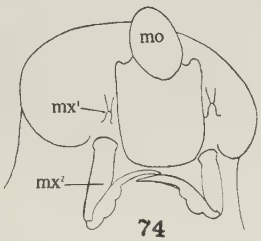
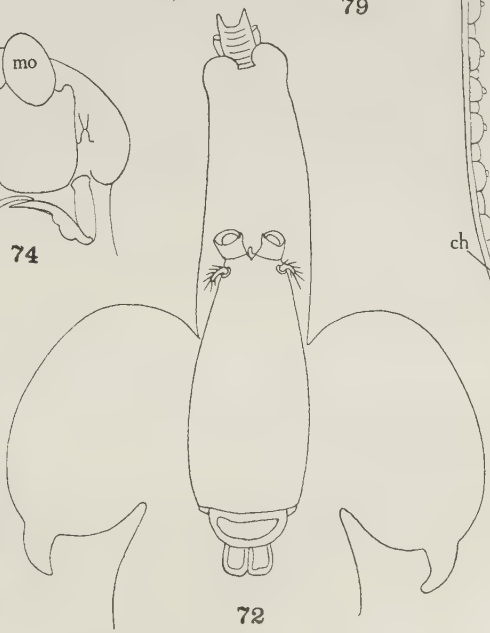


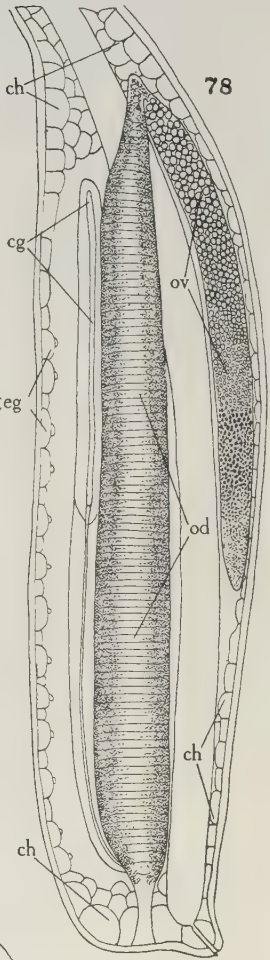






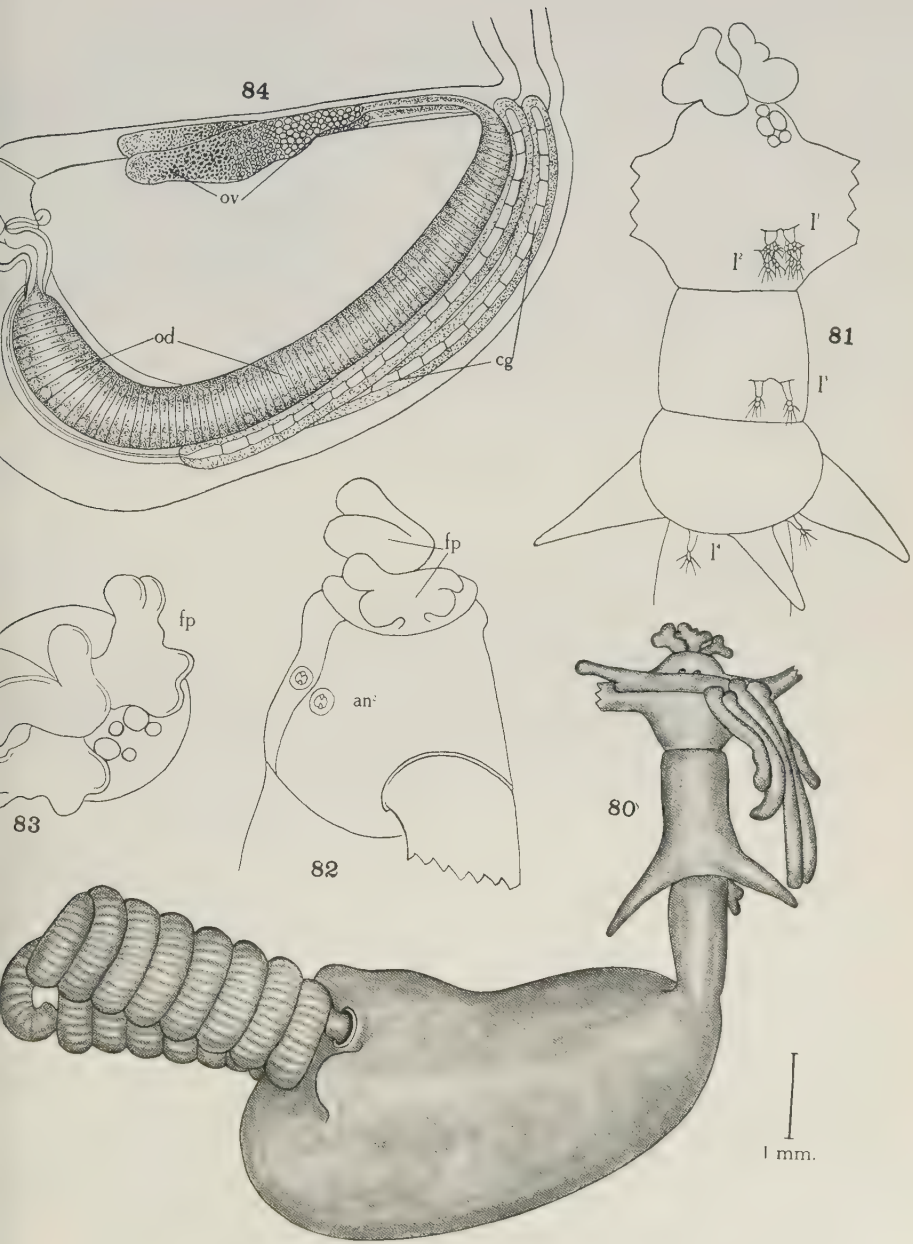






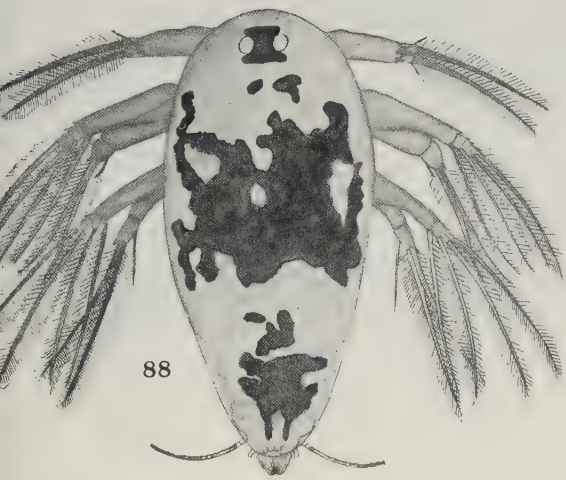
FEMALE OF SARCOTRETES LOBATUS.

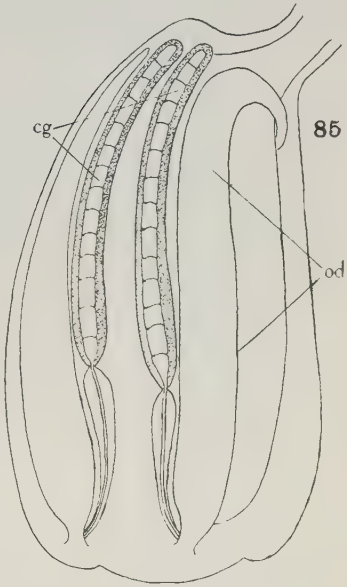
FOR EXPLANATION OF PLATE SEE PAGE 145.

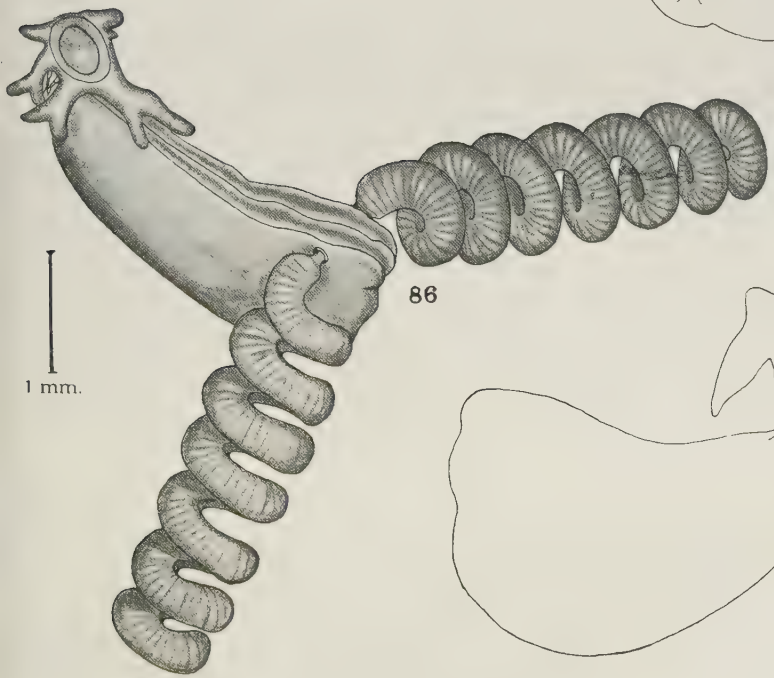


FEMALE OF PHRIXOCEPHALUS TRIANGULUS.

FOR EXPLANATION OF PLATE SEE PAGE 146.

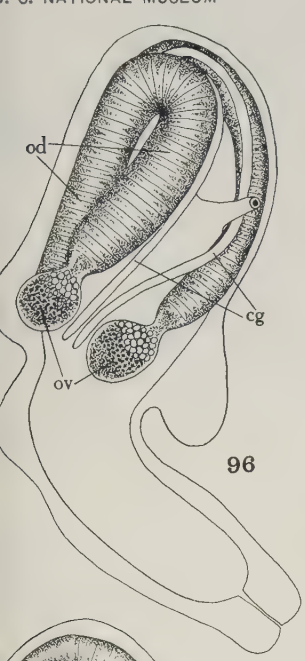






PHRIXOCEPHALUS TRIANGULUS, P. DIVERSUS, AND LERNAEOCERA BRANCHIALIS.

FOR EXPLANATION OF PLATE SEE PAGE 146.



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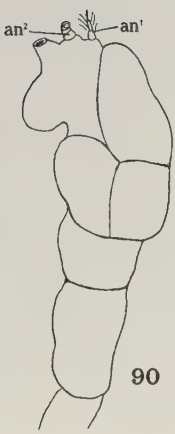

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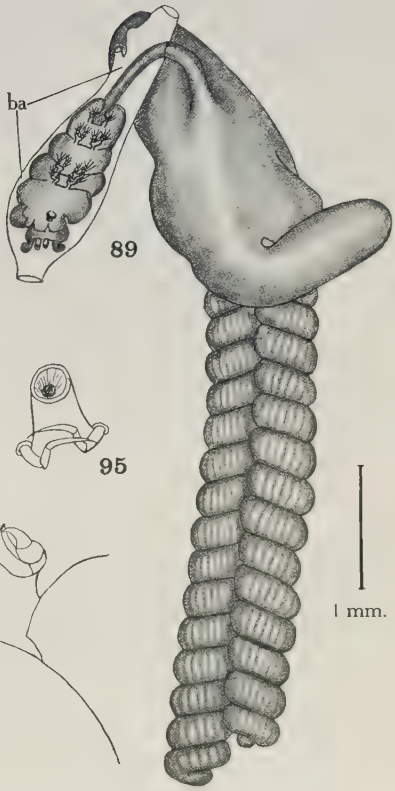

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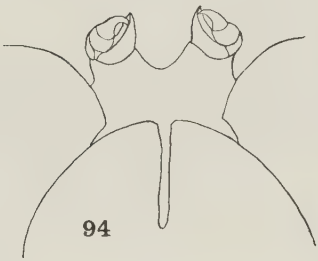

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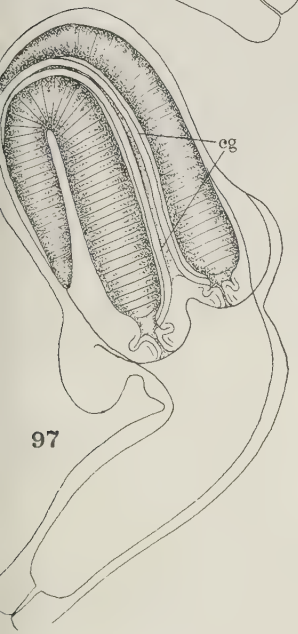

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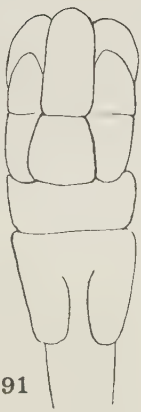

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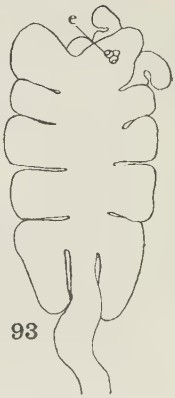
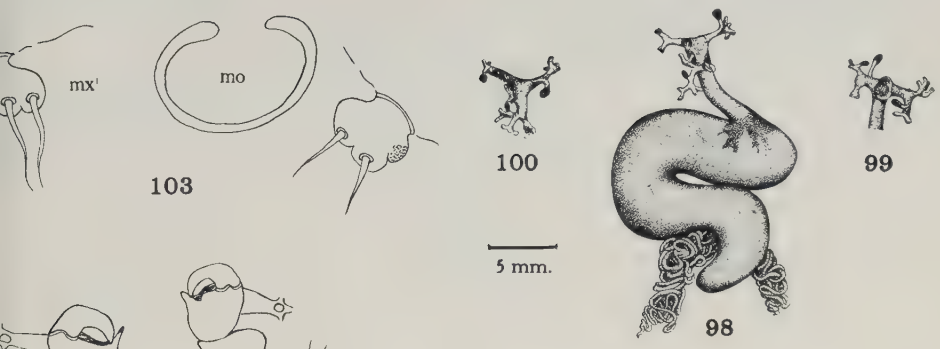
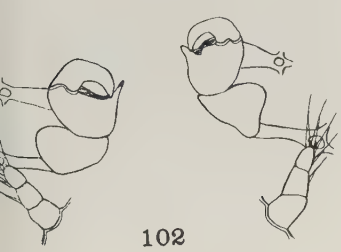


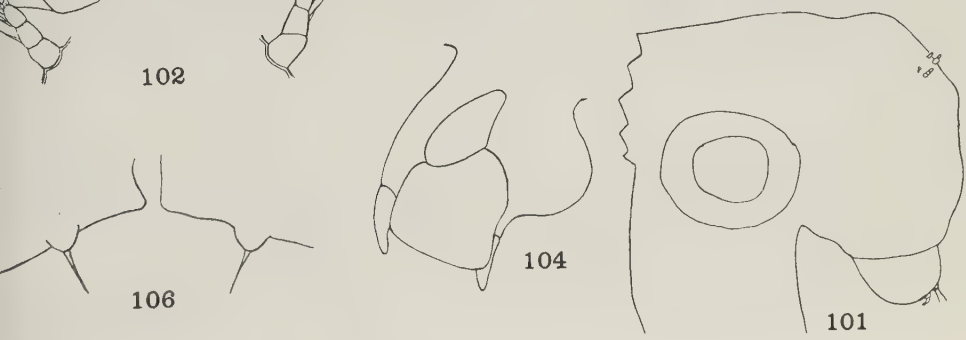
93

FEMALE OF COLLIPRAVUS PARVUS.

FOR EXPLANATION OF PLATE SEE PAGE 146.

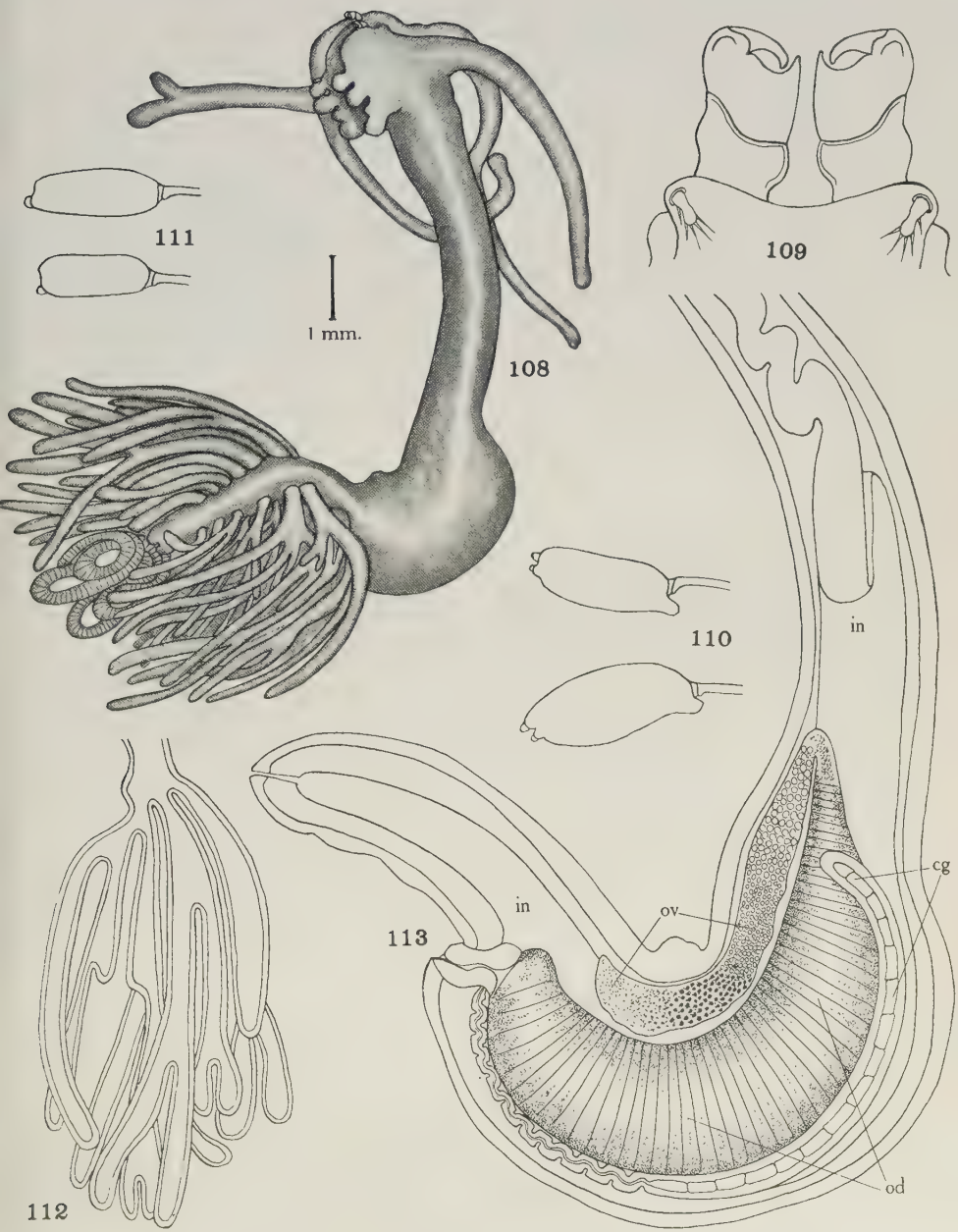






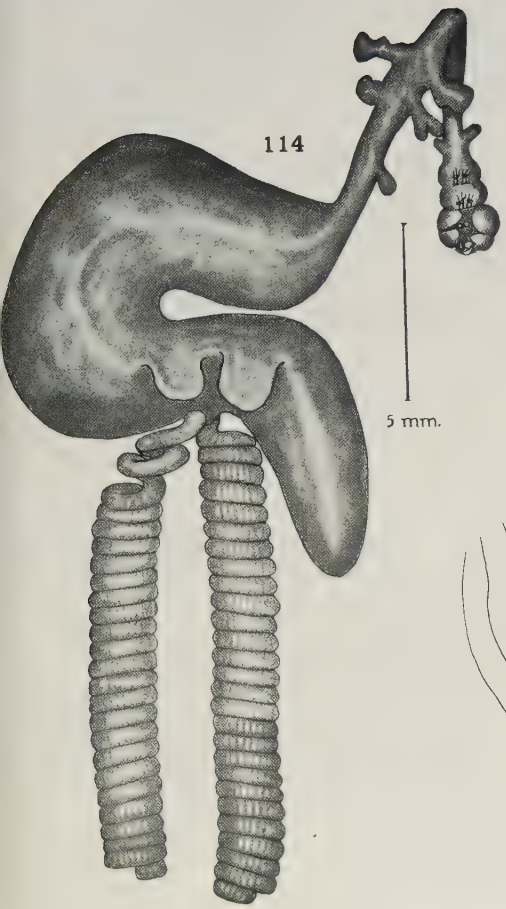
FEMALE AND NAUPLIUS OF LERNAEOCERA BRANCHIALIS.

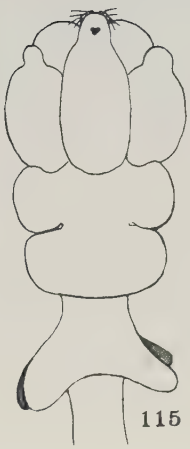
FOR EXPLANATION OF PLATE SEE PAGE 146.

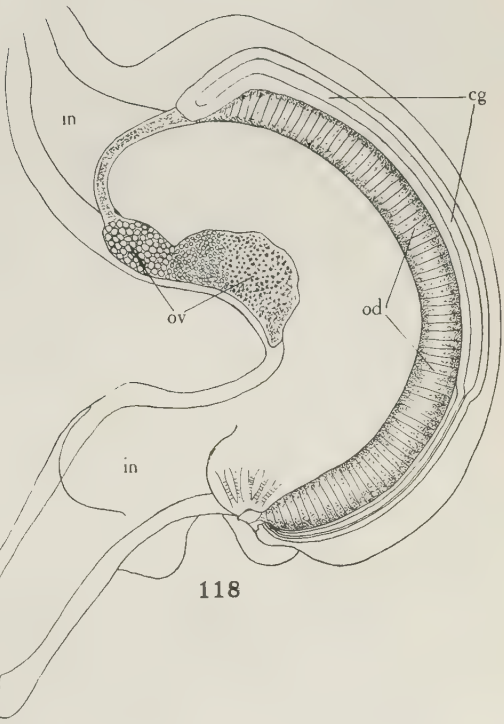


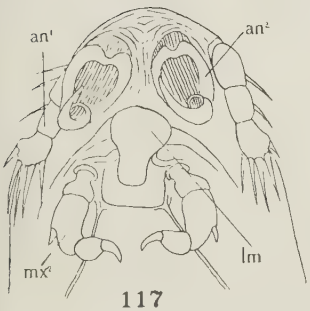
FEMALE OF LERNAEOLOPHUS SULTANUS.

FOR EXPLANATION OF PLATE SEE PAGE 146.



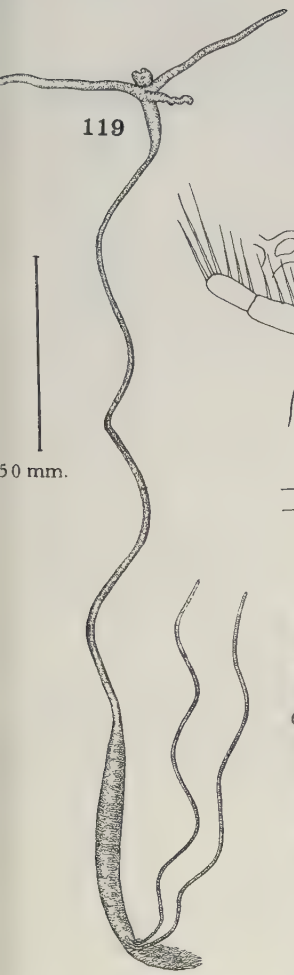


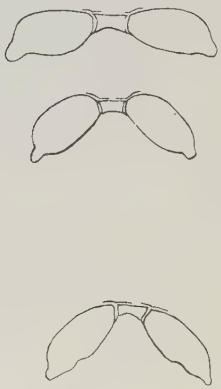


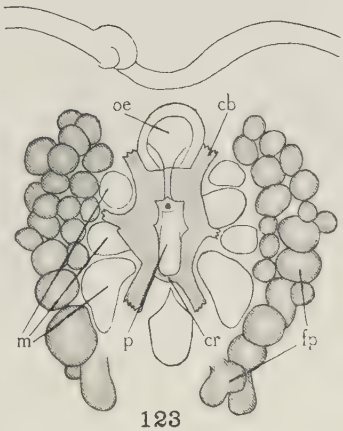


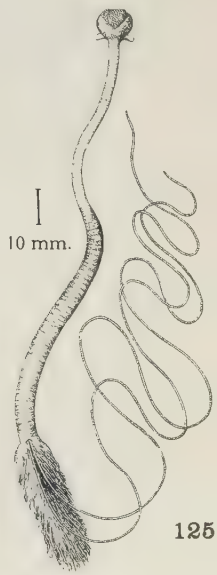
FEMALE OF HAEMOBAPHES CYCLOPTERINA.

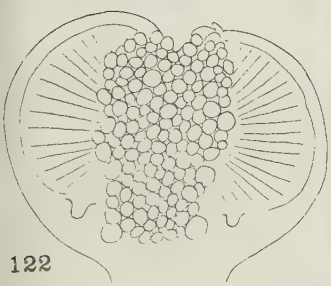
FOR EXPLANATION OF PLATE SEE PAGE 146.

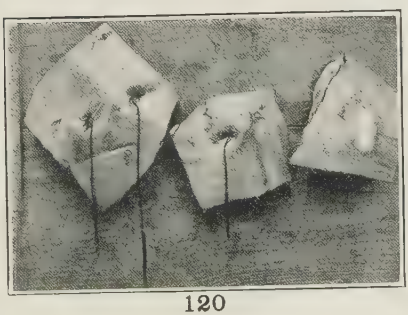






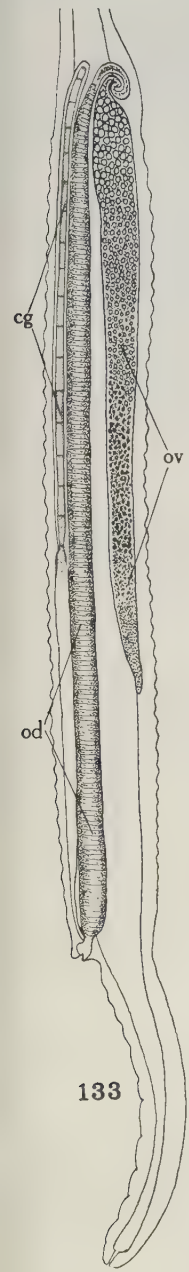






FEMALES OF PENNELLA ANTARCTICA AND P. FILOSA.

FOR EXPLANATION OF PLATE SEE PAGES 146, 147.



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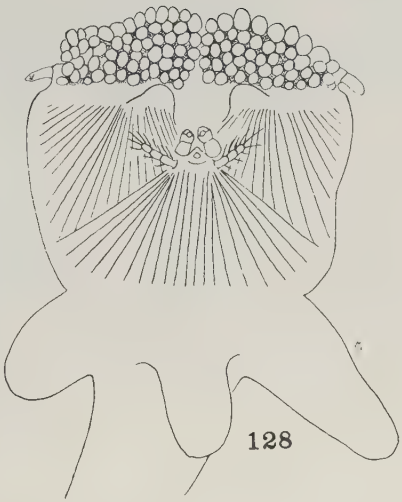

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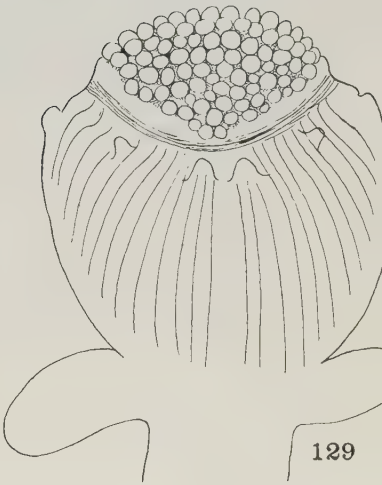

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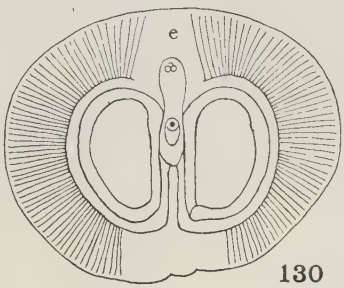

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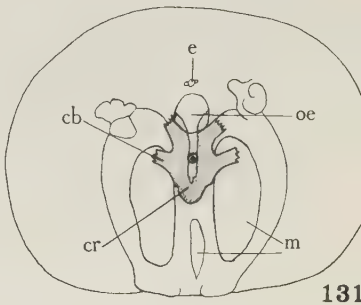

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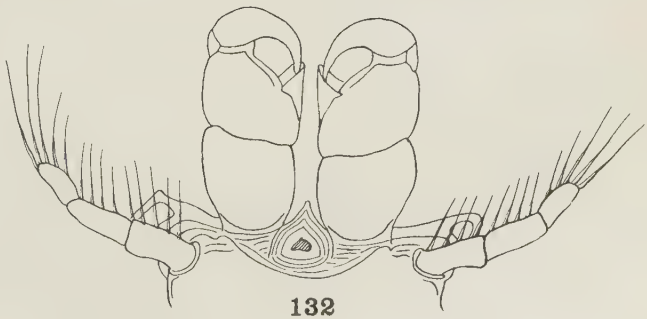
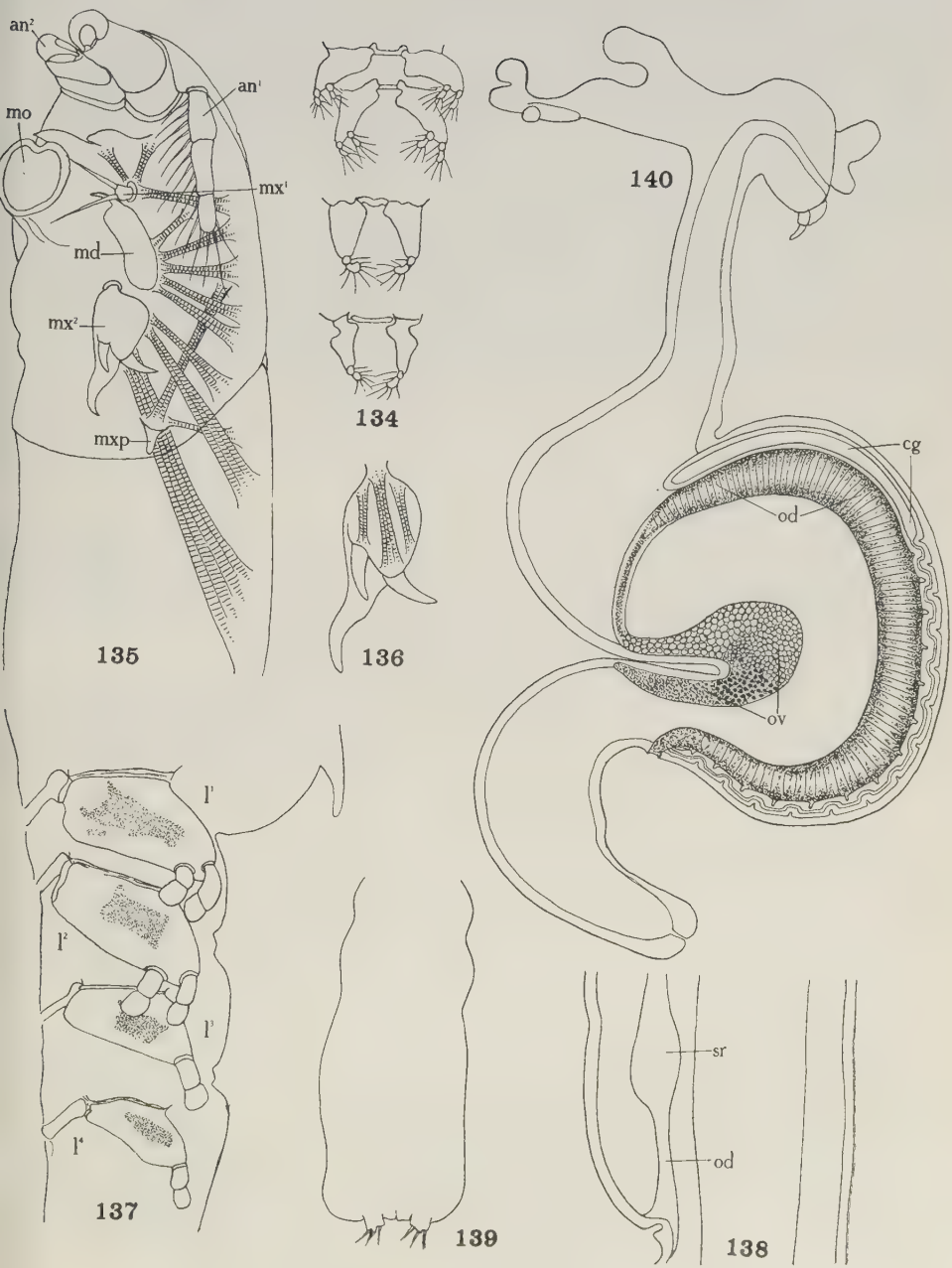


132

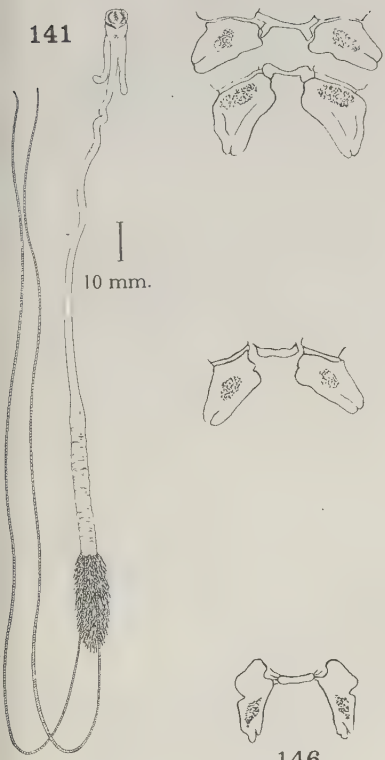
FEMALE OF PENNELLA FILOSA.

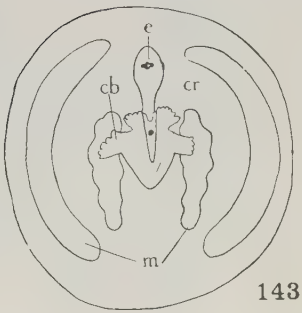
FOR EXPLANATION OF PLATE SEE PAGE 147.

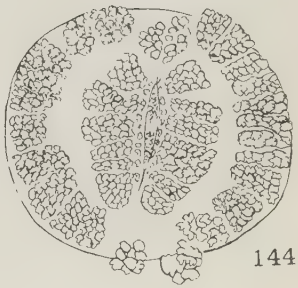


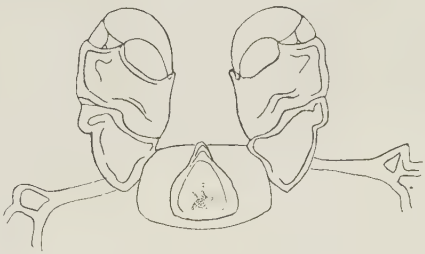
FEMALES OF PENNELLA FILOSA AND LERNAEOCERA BRANCHIALIS.

FOR EXPLANATION OF PLATE SEE PAGE 147.



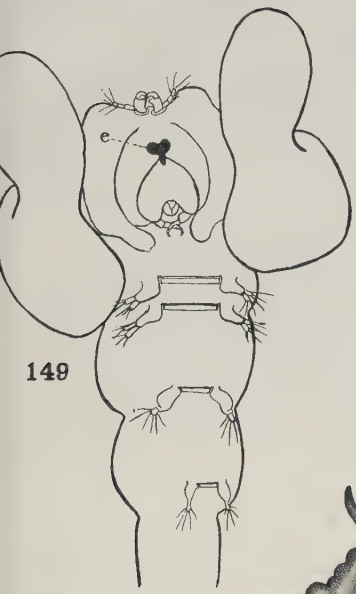


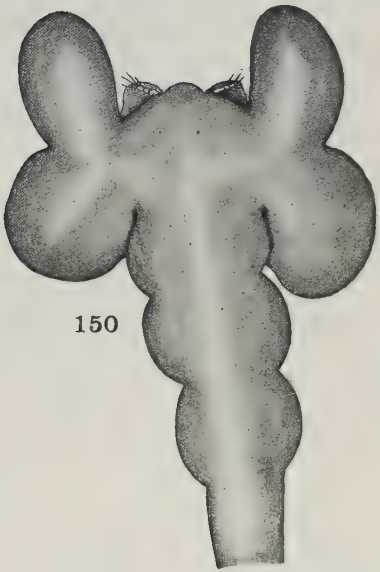


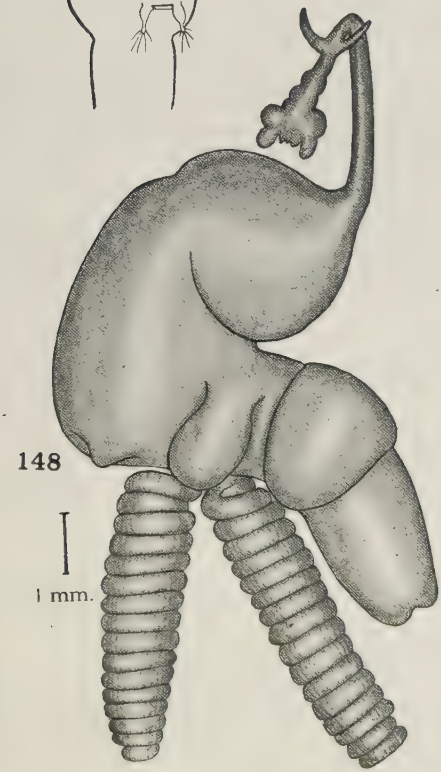


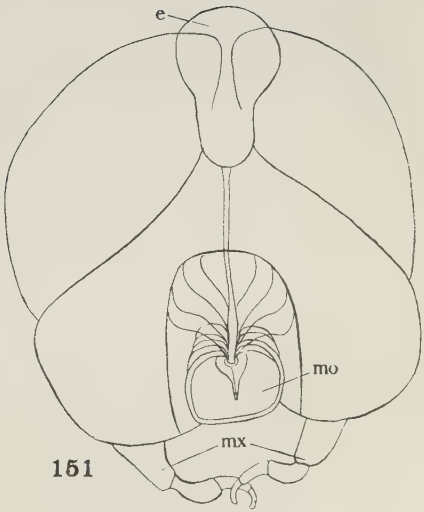
FEMALE OF PENNELLA INSTRUCTA.

FOR EXPLANATION OF PLATE SEE PAGE 147.



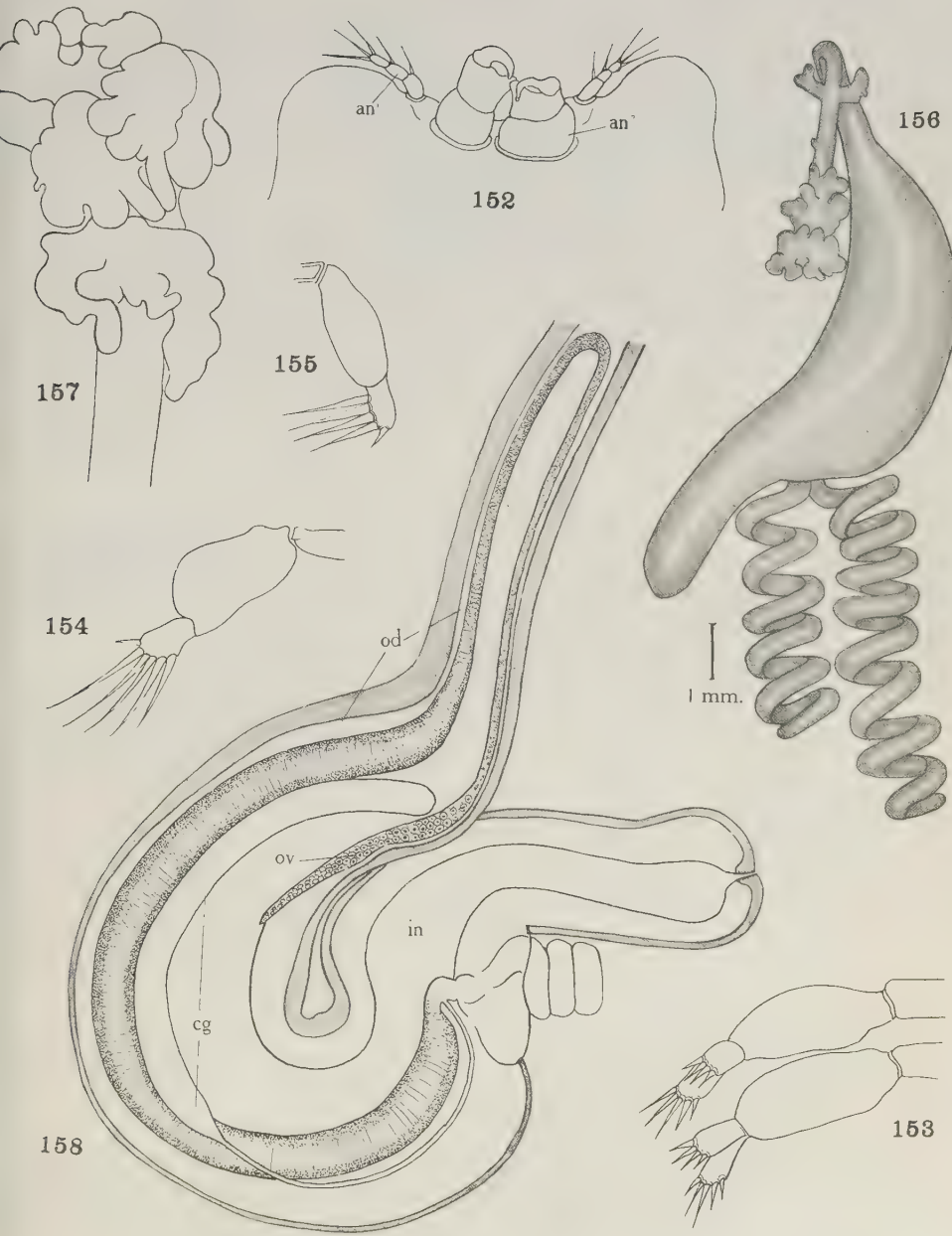






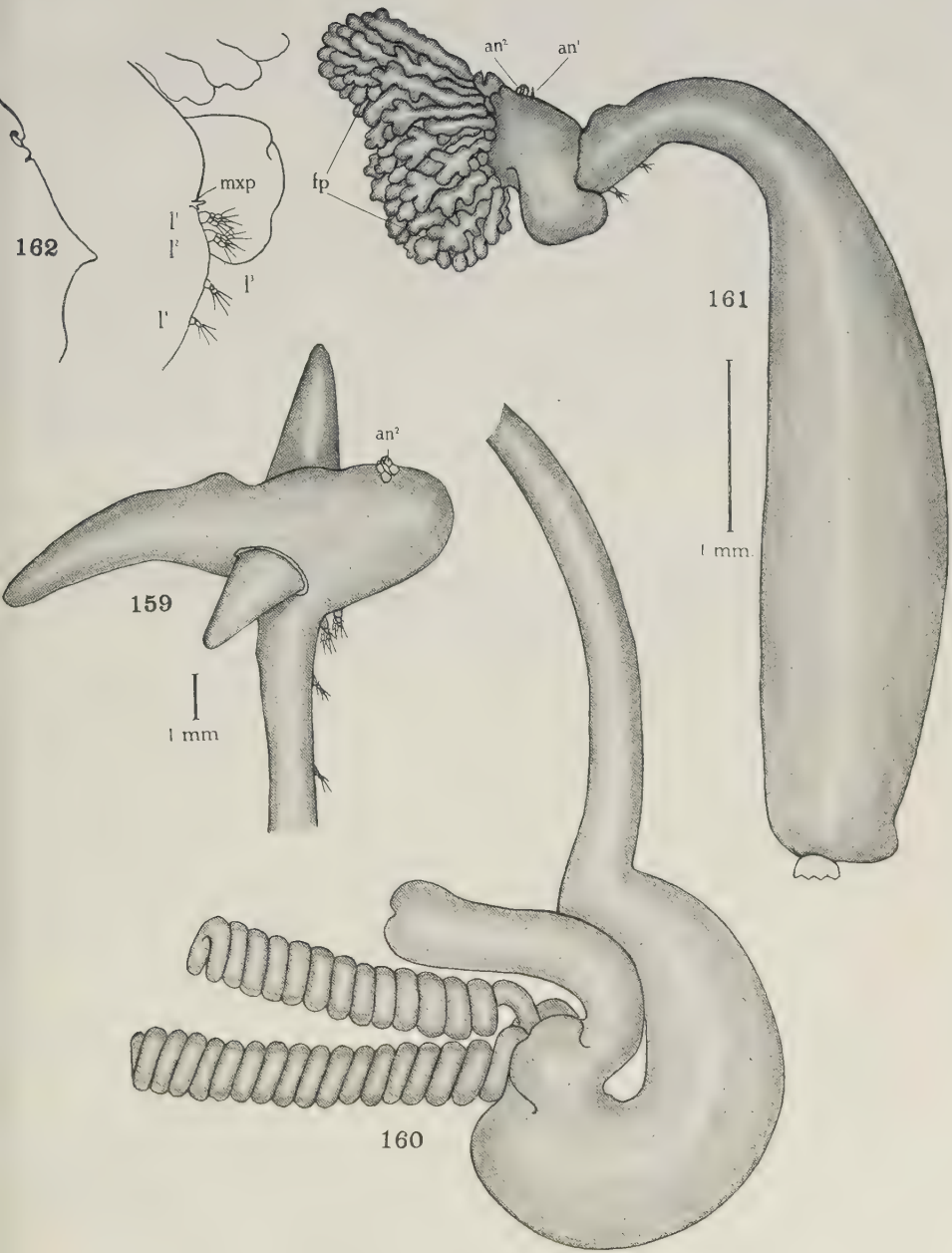
FEMALE OF HAEMOBAPHES DICERAUS.

FOR EXPLANATION OF PLATE SEE PAGE 147.



FEMALES OF HAEMOBAPHES DICERAUS, H. ENODIS, AND TRIFUR TORTUOSUS.

FOR EXPLANATION OF PLATE SEE PAGE 147.



FEMALES OF TRIFUR TORTUOSUS AND CARDIODECTES BELLOTTII.

FOR EXPLANATION OF PLATE SEE PAGE 147.

DESCRIPTIONS OF THIRTY-ONE NEW SPECIES OF HYMENOPTERA.

By S. A. Rohwer,

Of the Bureau of Entomology, United States Department of Agriculture.

The following paper, which is a contribution from the Branch of Forest Insects, Bureau of Entomology, contains the description of 31 new Hymenoptera, most of which have been reared as parasites of forest insects. The types of all the new species are in the United States National Museum collection.

Suborder Chalastogastra.

Superfamily TENTHREDINOIDEA.

TENTHREDELLA BIRMENSIS, new name.

Tenthredo gribodoi Konow, Ent. Nachr., vol. 24, 1898, p. 89, not *Tenthredo gribodoi* Costa, Rend. Acc. Napoli (2), vol. 3, 1894, p. 87.

MACROPHYA CASTANEAE, new species.

This species is related to *cassandra* Kirby, but may be separated from that species by the more coarsely punctured head and thorax and by the pale hind tarsi. It also resembles *dejectus* Norton, but differs from Norton's species in the black clypeus and in having the anterior margin of the cylpeus subsquarely emarginate with obtuse lobes. (The clypeus of *dejectus* is subsquarely emarginate with triangularly shaped pointed lobes.)

Male.—Length 8.5 mm. Labrum well exserted, apex subtruncate; clypeus shining with a few large, separate punctures, anterior margin deeply, subsquarely emarginate, the lobes at base half as broad as the emargination, their apices broadly rounded; supraclypeal area flat; supraclypeal foveae deep, punctiform; middle fovea, ocellar basin and the antennal furrows obsolete; head with large, close, sometimes confluent punctures which are more widely separated on the vertex and posterior orbits; posterior orbits with a sharp carina to the top of the eye; postocellar furrow poorly defined but complete;

postocellar area bounded laterally by line-like furrows, one and three-fourths times as wide as long; postocellar line one-third shorter than the ocellocular line; antennae rather long, tapering apically, third joint one-fourth longer than the fourth, the apical three joints sharply differentiated; scutum and prescutum shining but with large, distinct punctures which are very close along the sutures; scutellum with large punctures which are close and dense posteriorly; scutellar appendage punctured like the posterior part of the scutellum, with a median carina; mespeisternum coarsely punctured, confluently so dorsally; stigma regularly rounded below, truncate apically; transverse radius strongly curved before it joins the radius at the apical third of the third cubital; third cubital cell one-fourth shorter than the second on both radius and cubitus, one-fifth wider apically and slightly longer on the cubitus than on the radius, receiving the second recurrent vein at the basal fifth; abdomen shining, almost impunctate; hypopygidium subtruncate. Black; two spots on the clypeus, labrum, mandibles except apices, palpi, anterior femora beneath, the four anterior tibiae and tarsi beneath, trochanters, and the posterior tarsi *yellowish white;* wings uniformly hyaline, venation dark brown; the apex of the stigma paler.

Type-locality.—Vienna, Virginia. Described from one male recorded under Bureau of Entomology No. Hopk. U. S. 10161. This specimen was reared from a larva which was collected on *Castanea dentata* by R. A. Cushman; adult emerged May 29, 1913. The larva is an edge eater; in the last feeding stage it is yellow with black lateral spots; it is about 20 mm. long; in the prepupal condition it is pinkish with black stigmatal spots and a faint, small blackish subdorsal spot on each segment; head pale.

Type.—Cat. No. 19047, U.S.N.M.

EMPHYTUS MELLIPES, variety ALBOLABRIS, new variety.

Female.—Length, 9 mm. This variety is very like *mellipes mellipes*, but may be separated by the white labrum.

Described from one female collected at Departure Bay, Vancouver Island, July 5, 1913, by E. M. Walker.

Type.—Cat. No. 19212, U.S.N.M.

ERIOCAMPOIDES CASTANEAE, new species.

This species is related to *lunata* MacGillivray but differs from the original description of that species in the following characters: The hind tarsi are mostly black; the third antennal joint is not "considerably more than one and a half times as long as the fourth"; the third transverse cubitus is not about twice the length of the second transverse cubitus and is not bowed; the second joint of the hind tarsus is much longer than the third; abdomen is deep black; the

sheath is parallel-sided, not convex above and below, gradually rounding to a point at apex.

Female.—Length, 4.5 mm. Anterior margin of the clypeus broadly, arcuately emarginate, the surface shining, very sparsely punctured; the supraclypeal area flat, rectangular in outline; middle fovea transverse, deep; frontal fovea deep, punctiform, above the middle fovea; frontal crest well developed, broken in the middle; antennal foveae poorly defined; ocellar basin U-shaped, opened below; a very faint, shallow depression in front of the anterior ocellus; postocellar line subequal with the ocellocular line; postocellar furrow wanting; postocellar area subconvex, about two and one-half times as wide as the cephalcaudad length; third antennal joint one and one-third times as long as the fourth; thorax shining; stigma slightly tapering to the transverse radius, then sharply oblique to the apex; the second and third transverse cubiti subequal in length; the transverse radius in the apical third of the cell; second joint of the hind tarsi much longer than the third, almost as long as the third and fourth combined; inner tooth of the claw shorter than the outer; sheath approximately parallel-sided; the lower side gradually rounds to the acute upper apex. Black; the four anterior legs below the tips of the femora, the basal half of the posterior tibiae, and the basal third of the posterior basitarsus white; wings hyaline, faintly dusky; venation black.

Type-locality.—East Falls Church, Virginia. Described from two females recorded under Bureau of Entomology No. Hopk. U. S. 11307*a*, material collected as larvae July 13, 1913, by William Middleton. Adults emerging August 5 (type) and 13, 1913.

Type.—Cat. No. 15486, U.S.N.M.

The larva of this species is a typical greenish-white *Eriocampoides* larva, feeding on the ventral surface of the leaves of *Castanea dentata*. The head is pale ferruginous.

Genus PERICLISTA Konow.

Syn.: *Isodyctium* Ashmead.

Ashmead separated his genus *Isodyctium* from *Periclista* Konow by the sessile anal cell in the hind wings. This character is not of specific importance, it is subject to both individual and specific variation. In *diluta* Cresson there is a variation in seven female specimens from the same rearing of larvae, from sessile to distinctly petiolate. In some species (*lineolata*) the petiole is long; in others (*caryicola*) it is short, while in still others it is of intermediate length. From the standpoint of the genotypes no difference could be found except the relative length of the petiole of the hind anal cell. The genus *Isodyctium* is therefore considered as synonymous with *Periclista*.

PERICLISTA DILUTA (Cresson).

Selandria (*Monophadnus*) *diluta* CRESSON, Trans. Amer. Ent. Soc., vol 8, 1880, p. 12.

Isodyctium subgregarium DYAR, Journ. New York Ent. Soc., vol. 6, 1898, p. 134.

A comparison of the type of *subgregarium* Dyar with the homotype of *diluta* Cresson revealed no specific differences. The two species are therefore considered as synonymous.

PERICLISTA CALIFORNICA, new species.

Periclista mutabilis ROHWER, Can. Ent., vol. 41, 1909, p. 398. (Not Konow.)

In the pale inner orbits this species is related to *rileyi* (Cresson), but may be separated from that species by having the postocellar furrow angulate anteriorly and by the acuminate sheath.

Female.—Length 4 mm. Anterior margin of the clypeus deeply, arcuately emarginate, the lobes obtusely rounded apically; supraclypeal area uniformly convex; supraclypeal foveae deep, punctiform, not connected with the antennal foveae; middle fovea elongate, open above; frontal foveae obsolete; antennal furrows complete; ocellar area uniformly convex; ocellar basin obsolete; postocellar furrow angulate anteriorly; postocellar area narrowing posteriorly, its anterior width subequal with its length; postocellar line slightly longer than the ocellocular line; lateral ocelli well below the supraorbital line; antennae filiform, fourth and fifth joints subequal; stigma long, straight below, sharply oblique apically; anal cell of the hind wings with a long petiole; sheath straight above, oblique apically, slightly convex below. Yellowish; antennae except the scape beneath, head above the antennae inside of the antennal furrows and to the supraorbital line, spot on the prescutum, scutum, metanotum and six basal tergites medianly, *black;* wings hyaline, iridescent, venation pale brown; costa and stigma yellowish.

Type-locality.—Claremont, California. Described from one female collected by C. F. Baker.

Type.—Cat. No. 19040, U.S.N.M.

PERICLISTA HICORIAE, new species.

This species is closely allied to *murtfeldtae* Dyar, but may be distinguished from that species by having the apical margin of the clypeus depressed.

Female.—Length, 5 mm. Anterior margin of the clypeus arcuately emarginate, the lobes obtusely rounded, the apical margin depressed, the basal portion convex; supraclypeal area rectangular in outline, uniformly convex; supraclypeal foveae elongate, deep,

not connected with the antennal foveae; middle fovea represented by a large, shallow, slopping-walled depression; antennal furrows nearly complete; frontal foveae punctiform, obscure; ocellar basin triangular in outline, open below, the lateral walls sharply defined and meeting on the postocellar furrow; postocellar furrow straight; postocellar area two and one-half times as wide as long; the lateral furrows curved, complete, the area uniformly convex; postocellar line subequal with the ocellocular line; antennae filiform, the fourth joint slightly longer than the fifth; vertex shining; thorax shining; anal cell of the hind wings with a very short petiole; stigma long, broader at base, gradually tapering to the transverse radius, then sharply oblique; sheath strongly concave above, apex acute, gradually tapering to the base. Black; clypeus, labrum, spot on the mandibles, legs, and abdomen, except the two basal tergites and median spots on the following tergites, *yellowish;* the upper part of the mesepisternum, the margin of the prescutum, margin of the scutum, scutellum, and scutellar appendage, ferruginous; posterior margin of the pronotum and tegulae pallid; wings hyaline, venation brown, costa and stigma yellowish.

Male.—Length 5 mm. The depressed portion of the clypeus is narrower than in the female; otherwise the head characters are the same; hypopygidium obtusely pointed apically. Black; clypeus, labrum, spot on the mandibles, palpi, angles of the pronotum, tegulae, most of the tergites, sternites, and legs *yellowish white;* wings as in female.

Type-locality.—Charter Oak, Pennsylvania. Described from two females (one type) and one male recorded under Bureau of Entomology No. Hopk. U. S. 11364. The larvae of this species feed on *Hicoria glabra.* Material collected by T. E. Snyder and reared May 7, 1914, by William Middleton.

Type.—Cat. No. 19041, U.S.N.M.

PERICLISTA SIMILARIS, new species.

This species is closely allied to *albicollis* Norton, but may be differentiated from that species by the better defined ocellar basin, which is nearly triangular in outline, and by having the lower wall of the basin well defined. (The ocellar basin of *albicollis* is pentagonal in outline, the walls are rounded, and the lower walls poorly defined.)

Female.—Length, 5 mm. Clypeus flat, the apical margin broadly, subangulately emarginate, lobes obtusely rounded; supraclypeal area rectangular in outline, uniformly convex; supraclypeal foveae rather shallow, indistinctly connected with the antennal foveae; middle fovea represented by a shallow, sloping-walled, elongate depression;

frontal foveae nearly obsolete, punctiform; antennal furrows complate; ocellar basin triangular in outline, well defined, the lower wall distinct; postocellar furrow straight; postocellar area convex, about two and one-quarter times as wide as long; postocellar line subequal with the ocellocular line; antennae slightly tapering apically, the fourth joint distinctly longer than the third; stigma narrow, subangulate at base, tapering to the transverse radius, then gently oblique; anal cell of the hind wings with a long petiole; sheath broad, straight above, gradually rounding to base. Black; posterior margin of the pronotum, tegulae, and legs, except the brownish femora and coxae and the infuscate apical joints of the posterior tarsi, *yellowish;* the narrow apical margins and apical tergites ferruginous; wings hyaline, venation, including costa and stigma, black.

Type-locality.—Charter Oak, Pennsylvania. Described from one female recorded under Bureau of Entomology No. Hopk. U. S. 11363. Material collected by T. E. Snyder and reared May 7, 1914, by William Middleton. The larvae of this species feed on *Quercus alba*, and it may be that the larva recorded under the name *albicollis* from *Quercus alba* should properly be referred to this species. There are no specimens in the Dyar collection of *albicollis* which were reared from larvae on *Quercus alba*. All the reared specimens came from larvae feeding on *Quercus tinctoria*.

Type.—Cat. No. 19043, U.S.N.M.

PERICLISTA XANTHOGNATHA, new species.

In the general shape of the sheath and the pale mandibles this species resembles *occidentalis* Rohwer, from which it may be separated by the distinctly emarginate cylpeus.

Female.—Length, 6 mm. Robust. Labrum long, obstusely rounded apically; clypeus shining, flat, the apical margin distinctly arcuately emarginate, the lobes broad, rounded; supraclypeal area trapezoidal in outline, gently convex; supreclypeal foveae deep, punctiform, not connected with the antennal foveæ; middle fovea represented by a shallow depressed area: ocellar basin sharply defined above, open below: postocellar furrow straight; postocellar area convex, a little more than twice as wide as long, the lateral margin rounded; postocellar line distinctly longer than the ocellocular line; head shining, almost impunctate except the frontal area between the ocelli and the base of the antennae; antennae filliform, fourth joint very slightly longer than the fifth; thorax shining; stigma straight below, sharply oblique beyond the transverse radius; anal cell in the hind wings sessile; sheath straight above, the apex narrow, truncate, and very slightly upturned, from this projecting apex gradually rounded to base. Black; clypeus, labrum, spot on the mandibles, posterior margin of the pronotum, tegulae, legs, abdomen

except the middle of tergites one to eight (broader basally), *yellowish;* the margin of the prescutum, lateral margin of the scutum, part of the scutellum and upper part of the mesepisternum, ferruginous; wings hyaline, iridescent, venation pale brown, costa and stigma yellowish.

Type-locality.—Ithaca, New York. Described from one female labeled "from the Chittenden collection."

Type.—Cat. No. 19045, U.S.N.M.

ACORDULECERA HICORIAE, new species.

From *caryae* Rohwer, to which this new species seems to be most nearly allied, it may be separated by the black clypeus.

Female.—Length, 3.5 mm. Clypeus truncate; antennal foveae rather large, extending to the supraclypeal foveae; supraclypeal area slightly convex; middle fovea wanting; ocellar basin wanting; antennal furrows complete to the lateral ocelli; postocellar area not indicated; postocellar line distinctly longer than the ocelocular line; first joint of the flagellum markedly longer than the second; front sparsely clothed with short gray hair; stigma broadest at base, tapering rapidly toward the apex. Black; palpi, labrum and legs below the coxae yellowish; antennae piceous; wings dusky hyaline, venation dark brown.

Type-locality.—Charter Oak, Pennsylvania. Described from three females (one type) recorded under Bureau of Entomology No. Hopk. U. S. 11364*a;* larvae collected feeding on *Hicoria*, by T. E. Snyder; adults, which were reared by William Middleton, emerged May 20, 1914.

Type.—Cat. No. 18314, U.S.N.M.

Suborder Clistogastra.

Superfamily ICHNEUMONOIDEA.

Family EVANIIDAE.

PRISTAULACUS STRANGALIAE, new species.

Female.—Length 11.5 mm. Compared with the metatype of *Pristaulacus flavicrurus* Bradley from the Agricultural College, Michigan, this species differs as follows: The front impunctate; the hind coxæ hardly aciculate; posterior femora black; the upper part of the mesepisternum shining, sparsely punctured; metapleurae shining, below irregularly recticulate, above with a few strong, irregular carinae; the first tergite has a strong spine at the lateral middle. This last-mentioned character, if constant, will separate *strangaliae* from all other species of *Pristaulacus.*

Type-locality.—Charter Oak, Pennsylvania. Described from one female recorded under Bureau of Entomology, No. Hopk. U. S. 11812*a*, which refers to a note stating that this species is a parasite of *Strangalia luteicornis* in *Carpinus caroliniana.* Material collected and reared May 26, 1913, by F. C. Craighead.

Type.—Cat. No. 19387, U.S.N.M.

Family ICHNEUMONOIDAE.

CRYPTUS KOEBELEI, new name.

Cryptus ferruginous ASHMEAD, Proc. U. S. Nat. Mus., vol. 12, 1889, p. 412 (not Smith 1879 or 1861).

ODONTOMERUS STRANGALIAE, new species.

This species may be separated from *dichrous* Rohwer, its closest ally, by the basal area being almost completely closed, by the posterior lateral bases of the scutellum and the depression of the metanotum being without rugae, different venation, smaller size. etc.

Female.—Length 7 mm.; length of ovipositor 8 mm. Head below the antennae shining, with sparse, irregular punctures, in addition the median portion finely granular; above the antennae to the posterior orbits shining, impunctate; ocelli in a little less than an equilateral triangle; the postocellar line distinctly shorter than the ocellocular line; third antennal joint distinctly longer than the fourth, the joints not nodose apically; scutum shining, with a few well-defined punctures; the notauli not foveolate; posterior portion of the prescutum with five rugae, the median one being more prominent; dorsal aspect of the scutellum sculptured like the scutum; the lateral posterior aspect of the scutellum and the depressed area of the metanotum with a few very weak and poorly defined raised lines; dorsal aspect of the propodeum shining, the basal area with sides and basal width subequal, almost completely closed; the areola hexagonal; the anterior lateral legs one-fourth longer than the posterior lateral legs, the posterior margin less by one-fifth than the length of the posterior lateral legs; the angles of the propodeum on the dorsal lateral corners; sides of the propodeum practically impunctate; second recurrent vein much more than the length of the transverse cubitus beyond the transverse cubitus. Black; palpi yellowish; legs and abdomen, except two apical tergites which are piceous, rufous; head, thorax, and legs with long, white hair; wings hyaline, iridescent; venation brown.

Type-locality.—Ballston (Veitch), Virginia. Described from one female recorded under Bureau of Entomology, No. Hopk. U. S. 12280*x*, which refers to a note which indicates that this species is

parasitic on *Strangalia luteicornis* breeding in grape. Specimen reared by H. B. Kirk, emerging March 17, 1914, material collected by F. C. Craighead.

Type.—Cat. No. 18999, U.S.N.M.

PYRACMON CONOCOLA, new species.

Female.—Length 7.5 mm.; length of ovipositor beyond the tip of the abdomen 2.5 mm. Lower tooth of mandibles slightly longer than the upper; clypeus slightly rounded; malar space slightly shorter than the width of the mandibles at base; head except the shining posterior orbits, finely shagreened; posterior orbits straight; ocellocular line subequal with the interocular line; mesepisternum shining with sparce well defined punctures; propodeum shining with strong well defined carinae; areola and petiolar areas confluent, transversely rugose; abdomen shining, smooth; lateral carinae of the petiole strong and rather high; no carinae from the spiracles to the apex of the first tergite; second tergite shorter than the two following, its apical width one-fourth greater than its basal width; spiracle in middle; an indistinct gastrocoelus near the base; radius obtusely angulate, second abscissa one-third longer than the first; nervellus broken a little below the middle. Black; body clothed with short gray pubescence which is denser on the face; palpi and tegulae white; spot on the mandibles and scape beneath piceous; legs red; coxae and first joint of hind trochanters black; the apex of the posterior tibiae and their tarsi brownish. Wings hyaline, iridescent; venation black; lower margin of stigma dark brown.

Male.—Length 7 mm. Except that the mandibles are almost entriely white and that the second joint of the hind trochanters and hind tibae and tarsi are strongly infuscated, the male does not differ essentially from the female.

Type-locality.—Colestin, Oregon, and Julian, California. Described from two females, (one type) recorded under Bureau of Entomology No. Hopk. U. S. 12535*t*[2], and from one female and one male recorded under Bureau of Entomology No. Hopk. U. S. 13278*f*. These numbers refer to notes stating that the species is parasitic on *Pinipestis*, species living in the cones of *Pinus coulteri*, and probably a parasite of *Evetria taxifoliella* in cones of *Pseudotsuga taxifolia*. Material collected by F. P. Keen and P. D. Sargent.

Type.—Cat. No. 20181, U.S.N.M.

ANGITIA MILLERI, new species.

Female.—Length, 4.5 mm.; length of ovipositor beyond the tip of the abdomen, 2.5 mm.; length of antennae, 4.5 mm. Teeth of the mandibles subequal; anterior margin of the clypeus gently rounded; head

shagreened; scutum shagreened, convex, anterior middle somewhat shining and with a number of large, poorly defined punctures; mesepisternum shagreened with a number of large, poorly defined punctures; propodeum shagreened; carinae weak, obsolete posteriorly, so the middle basal area is the only area completely defined; the costulae are present; abdomen shagreened; petiole and postpetiole shining; spiracles of first tergite rather prominent, no carinae from them to apex of segment; second tergite shorter than two following, its posterior width twice as great as the anterior width; spiracle at the middle, a small lanulae midway between the spiracles and base; radius obtusely angulate; first abscissa one-half as long as second; areolet petiolate; petiole (in wing) as long as cell; nervellus broken below the middle. Black; mandibles, palpi, scape beneath, tegulae, four anterior coxae, and trochanters whitish; legs ferruginous; posterior coxae, spot on intermediate pair, apex of the posterior femora, four anterior tibiae, and tarsi dark brown or black. Wings hyaline, iridescent; venation black.

Type-locality.—Ashland, Oregon. Described from one female recorded under Bureau of Entomology No. Hopk. U. S. 10833*d*[3], which refers to note stating that the species was reared from cones of sugar pine infested with *Dioryctria abietella*. Material collected by P. D. Sargent, reared by J. M. Miller, for whom the species is named.

Type.—Cat. No. 20178, U.S.N.M.

ANGITIA TINEAVORA, new species.

Female.—Length, 4.5 mm.; length of ovipositor beyond the tip of the abdomen, 1.75 mm. Teeth of the mandibles subequal; clypeus nearly truncate; face shagreened; mesonotum shagreened and with a few distinct punctures; middle basal area triangular; areola and petiolar areas transversely striate on a granular surface; carinae of propodeum strong; mesepisternum and sternum granular with a number of large, not especially distinct, punctures; no carinae from the spiracle to the end of first tergite; second tergite as long as the two following combined, granular, the spiracles slightly beyond the middle, no lanulae; radius obtusely angulate, first abscissa one-fourth shorter than the second; areolet small, petiolate, petiole as long as the cell (in some wings the areolet is wanting); discoidal cell at base narrower than length of nervulus; nervellus broken below the middle. Black; clypeus, palpi, scape, pedicel, and tegulae whitish; legs ferruginous to rufo-ferruginous; four anterior tarsi paler; the spot on the posterior coxae and apices of posterior tibiae and their tarsi brownish. Wings hyaline, iridescent; venation dark brown.

Male.—Length, 5 mm. Differs from female in having scape and pedicel black above; anterior coxae and trochanters are whitish; the usual silvery pubescence on the face is more pronounced.

Type-locality.—Mistletoe, Oregon. Described from two females and one male. Recorded under Bureau of Entomology No. Hopk. U. S. 14210*b*, which refers to a note stating that this species is parasitic on Tineid moths infesting the fruit body of *Polyporus dryophilus.* Material collected and reared by J. M. Miller.

Type.—Cat. No. 20177, U.S.N.M.

MELEBORUS LASPEYRESIAE, new species.

Female.—Length, 7.5 mm.; length of the ovipositor beyond the end of the abdomen, 1.25 mm. Teeth of the mandibles equal; anterior margin of the clypeus rounded; malar space less than the width of the mandibles at the base; head shagreened; ocellocular line slightly less than the broadest diameter of the lateral ocellus; posterior orbits nearly straight, two-thirds of the cephala-caudad diameter of the eyes; mesothorax shagreened in addition to distinct, well-defined rather close punctures; propodeum with well-defined strong carinæ; basal lateral areas with punctures in addition to shagreening, posterior areas without punctures; petiole with a few irregular lines above; postpetiole shagreened; no carinae from spiracle of first tergite to apex; second tergite subequal in length to two following, its posterior width one-third greater than its anterior; its entire surface shagreened; the spiracles distinctly beyond the middle with a small tubercle nearer the spiracle than the base; radius obtusely angulate, the second abscissa one-third longer than the first; discoidal cell distinctly narrower posteriorly than the length of the nervulus; second intercubitus entirely wanting; nervellus slightly broken at about the middle. Black; mandibles, palpi, scape, pedicelum beneath, tegulae, four anterior trochanters, the second posterior trochanters and anterior tarsi yellowish white; legs below the trochanters rufous, posterior femora and apices of the posterior tibiae and posterior tarsi somewhat brownish, the color being more intense on the tarsi. Wings hyaline, irridescent; venation dark brown.

Type-locality.—Talent, Oregon. Described from two females recorded under Bureau of Entomology, No. 11492*e*, which refers to a note stating that the species is parasitic on *Laspeyresia toruta* living in the cones of *Pinus ponderosa.* Material collected by P. D. Sargent and reared by J. M. Miller.

Type.—Cat. No. 20180, U.S.N.M.

PHADROCTONUS ARGYRESTHIAE, new species.

This species is easily distinguished from *minutus* Ashmead, by the short ovipositor.

Female.—Length, 4.5 mm; length of ovipositor beyond the end of the abdomen, 0.75 mm. Teeth of the mandibles equal; clypeus truncate; head shagreened; ocellocular line subequal with the shortest diameter of the lateral ocellus; thorax shagreened in addition to some scattered, poorly-defined punctures; carinae of the propodeum strong; middle basal area practically obsolete because the carinae parallel each other; petiolar area transversely striate; petiole and postpetiole shining; no carinae from spiracles to apex of first segment; second tergite longer than the two following, twice as wide posteriorly as basally; the spiracles beyond the middle, the small lanulae slightly nearer the spiracles than the base of the segment; radius obtusely angulate; second abscissa slightly more than twice as long as first; nervellus not broken. Black; mandibles, palpi, scape, pedicel underneath, tegulae, anterior coxae, four anterior trochanters and spot on intermediate coxae beneath, yellowish white; apical margin of the second and following tergites, apical sternites, fulvo-ferruginous; legs fulvo-ferruginous; coxae, except where mentioned, black; posterior femora slightly brownish base and apices of the posterior tibiae blackish; posterior tarsi and apical joint of the intermediate pair blackish. Wings hyaline, irridescent; venation black.

Male.—Length, 5 mm. Except that the pale color is more yellow it does not differ essentially from the female.

Type-locality.—Ashland, Oregon. Described from 3 females and 3 males recorded under Bureau of Entomology, No. Hopk. U. S. 12565*d*[3], which refers to a note stating that this species is a parasite on a species of *Argyresthia* living on *Libocedrus decurrents.*

Type.—Cat. No. 20179, U.S.N.M.

BOETHUS SCHIZOCERI (Howard).

Eubadizon schizoceri HOWARD, Insect Life, vol. 1, p. 44, fig.
Boethus howardi DAVIS, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 290.
Boethus daeckei VIERECK, Proc. Ent. Soc. Wash., vol. 11, 1909, p. 210.

It was unnecessary for Davis to propose a new name for this species. His own reference proves that he had the material which Doctor Howard figured. The specimen from which the drawing was made is in the United States National Museum, and it is one of the types of *Boethus howardi. Boethus daeckei* is the male of *schizoceri.* Rearings from the host of this species indicate that the color of the fore legs may vary from brownish to yellowish.

Family BRACONIDAE.

COSMOPHORUS PITYOPHTHORI, new species.

This species is closely allied to but may be readily separated from *hopkinsi* Ashmead by the sculpturing of the first tergite, the darker and shorter first abscissa of radius.

Female.—Length 2.5 mm; length of ovipositor .75 mm. Head shining; antennae slender, 14-jointed, the third and fourth joints subequal; mesoscutum shining; propodeum granular with the faint carina separating the dorsal and posterior aspects; discocubitus joining the radius so near base that there is no real first abscissa of radius; first tergite striato-granular; remaining tergites shining impunctate. Black; legs and abdomen beyond first segment dark piceous; wings hyaline, faintly dusky, venation pale brown.

Male.—Length 1.75 mm. Differs from the female in having a few striae at the base of the second tergite; and in the 13-jointed antennae.

Type-locality.—Moraga Ridge, Oakland, California. Described from three females (one type) and one male (allotype) reared from twigs of *Pinus tuberculata* infested by *Pityophthorus*, species. Material collected by F. P. Keen.

Type.—Cat. No. 19951, U.S.N.M.

Genus DIOSPILUS Haliday.

As used here the genus *Diospilus* agrees with the characterization given by Szepligetti. However, the last two species described are not typical in venation and might be the types of a new group, but it seems to the author that the characters offered for the genera of this subfamily are not such that they may be expected to hold for a large number of species. He has therefore considered it advisable to place *californicus* and *neoclyti* in the genus *Diospilus*.

A. CLYPEUS NOT SHARPLY DEFINED LATERALLY; WIDTH FULLY THREE TIMES AS GREAT AS THE MEDIAN LENGTH; FIRST ABSCISSA ON THE RADIUS LESS THAN ONE-FIFTH THE LENGTH OF THE SECOND.

DIOSPILUS WASHINGTONENSIS, new species.

Female.—Length 6 mm.; length of the ovipositor 7 mm.; length of the antennae 4 mm. Clypeus shining, with large separate punctures; head immediately below the antennae transversely striato-punctate, rest of the head below the antennae with sparse, well separated punctures; head above the antennae and posterior orbits shining, impunctate; ocelli in an equilateral triangle; third antennal joint slightly longer than the fourth; prescutum, scutellum, and

scutum shining, nearly impunctate; suture between the scutum and the scutellum with three strong rugae; the posterior lateral aspects of the scutellum and a depressed area of the metanotum with rugae; the metanotum medianly with two prominent carinae which converge until they meet in the form of a rounded tubercle at the apical middle margin; propodeum reticulate, basal median area more finely so, the basal lateral areas finely punctured; mesepisternum sculptured like the scutum except for the obliquely foveolate depression; first abscissa of the radius about one-sixth or less than the length of the second; second cubital cell slightly narrowed below; recurrent vein basad of the first transverse cubitus by about one-third the length of the first transverse cubitus; nervulus interstitial; first tergite longitudinally striate; extreme base of the second tergite finely, irregularly aciculate; the apex of the second and all of the following tergites shining, impunctate. Black; clypeus, mandibles except apices and scape beneath rufo-piceous; palpi and tegulae pale yellow; legs rufous, apical fourth of the posterior tibiae dusky; wings hyaline, venation pale brown; body with short, gray hair.

Type-locality.—Easton, Washington. Described from one female collected by Koebele.

Type.—Cat. No. 19003, U.S.N.M.

B. CLYPEUS SHARPLY DEFINED LATERALLY; ABOUT TWO AND ONE-HALF TIMES AS WIDE AS LONG; FIRST ABSCISSA ON THE RADIUS BUT LITTLE SHORTER THAN THE SECOND.

a. First two tergites red, the second completely sculptured.

DIOSPILUS CALIFORNICUS, new species.

Female.—Length 5 mm.; length of the ovipositor 4.5 mm.; length of the antennae 3.75 mm. Apical margin of the clypeus narrowly depressed, the surface shining, sparsely punctured; head below the antennae with separate, well-defined punctures, which are more widely separated medianly and laterally; head above the antennae and posterior orbits shining, practically impunctate; ocelli in a little less than an equilateral triangle; latrad or each lateral ocellus is a narrow, elongate, crescent-shaped fovea; third and fourth antennal joints subequal; prescutum depressed posteriorly, reticulate; notauli strongly foveolate; scutum, prescutum, and most of the mesepisternum shining, impunctate; sides of the pronotum coarsely reticulate; suture between the scutum and scutellum with one ruga; posterior lateral aspects of the scutellum and depressed area of the pronotum with rather weak rugae; metanotum medianly with two carinae, which converge posteriorly and meet in the form of an elongate flattened area in the apical middle; propodeum coarsely reticu-

late, dorsal middle with median carina; dorsal lateral areas shining, impunctate; second cubital cell slightly narrower above; first recurrent vein shortly antifurcal; nervulus interstitial; first two tergites longitudinally striato-reticulate; lateral margins of the second tergite and all of the following tergites shining, impunctate. Black; palpi and tegulae pale yellowish; legs and first two tergites rufous; wings hyaline, iridescent, venation pale brown; stigma darker.

Type-locality.—Santa Cruz Mountains, California. Described from two females (one, type) from the collection of Ashmead.

Type.—Cat. No. 19004, U.S.N.M.

b. Tergites black, second sculptured at base only.

DIOSPILUS NEOCLYTI, new species.

Male.—Length, 6.5 mm.; length of the antennae, about 4 mm. Anterior margin of the clypeus scarcely depressed, the surface shining, almost impunctate; dorsal margins sharply defined by punctiform foveae; head below the antennae shining, with separate, uniform, well-defined punctures; head above the antennae and posterior orbits shining, practically impunctate; ocelli in a low triangle, without well-defined depressions laterally; third antennal joint slightly shorter than the fourth; prescutum reticulate posteriorly; notauli strongly foveolate; suture between the scutum and scutellum with one ruga; prescutum, scutum, scutellum and mesepisternum shining, practically impunctate; sides of the pronotum recticulate; metanotum, propodeum, and venation as in *californicus;* the first tergite and the base of the second longitudinally striato-reticulate, the reticulations predominating on the second tergite, the striations on the first; the apical margin of the second and all of the following tergites shining, impunctate. Black; palpi yellowish; legs rufous; posterior tibiae and tarsi dusky; tegulae yellowish; wings hyaline, venation pale brown; body with short gray pile.

Type-locality.—North Cheyenne Canon, Colorado. Described from one male recorded under Bureau of Entomology, No. Hopk. U.S.11924, which refers to a note stating that this is a parasite of *Neoclytus caprae* Say breeding in *Quercus gambelli*, material collected by A. B. Champlain and reared by H. B. Kirk, adult emerging April 6, 1914.

Type.—Cat. No. 19005, U.S.N.M.

This may possibly be the male of *californicus*, but as there is difference in the sculpturation and color it seems advisable to consider it as a distant species.

PHANEROTOMA ERYTHROCEPHALA, new species.

In structure this species falls near *tibialis* Haldeman, but may readily be distinguished by the sides of the propodeum being more coarsely sculptured than the mesepisternum and by the reddish head and black thorax and abdomen.

Female.—Length, 5 mm. Head rounded behind the eyes, the cephal caudad length of the posterior orbits about two-thirds the diameter of the eye; eyes strongly convex, oval; malar space slightly longer than the width of the mandibles at base but much less than the length of the eye; clypeus shining, more convex basally, the apical margin tridentate; supraclypeal fovea poorly defined, the interfoveal line shorter than the length of the clypeus; face rather coarsely sculptured with irregular lines and granulations; frons and vertex with irregular (mostly transverse) lines; ocelli in an equilateral triangle; notauli obsolete; scutum granular with a few scattered punctures, the posterior middle reticulate; scutellum punctured on a granular surface; dorsal surface of propodeum irregularly punctured and with a few irregular lines; mesepisternum granular, with a few punctures posteriorly; sides of propodeum more coarsely sculptured than mesepisternum; carapace nearly uniformly coarsely reticulate; recurrent interstitial; nervulus and second abscissa of discoideus forming an acute angle; first and second abscissa of radius subequal. Black; head, except interocellar area, scape, pedicellum, prothorax, tegulae, ferruginous; legs ferruginous, apices of hind femora and tibiae blackish; wings hyaline without bands, costa, subcosta and stigma black; rest of venation pale brown.

Male.—Length 5 mm. Characters as in female.

This species varies in the amount of ferruginous on the prothorax and in having the first abscissa of radius slightly shorter than the second.

Type-locality.—Glenwood Springs, Colorado. Described from two females and one male (allotype) with Bureau of Entomology number Hopk. U.S.10857*f*, which refers to note stating that this species is probably a parasite of *Laspeyresia toruta* living in the cones of *Pinus ponderosa*. Material collected by J. J. Lowell and reared by J. M. Miller.

Type.—Cat. No. 20174, U.S.N.M.

MACRONEURA URICHII, new species.

This species is apparently closely allied to *Macroneura consobrinus* (Szépligèti), from which it can be easily distinguished by the longer ovipositor and pale four anterior legs.

Female.—Length of body 18 mm.; length of ovipositor 42 mm.; length of antennae 18 mm. Face reticulate; front and posterior orbits smooth; ocelli surrounded by a furrow which extends to between bases of antennae; third antennal joint distinctly longer than the fourth; thorax smooth, shining; posterior coxae more than half as long as their femora; longer spur of the posterior tibiae one-third the length of the hind basitarsus; abdomen smooth and shining. Black; four anterior legs, the hind trochantine and base of hind tibiae fulvo-ferruginous; first three tergites rufo-ferruginous; wings yellow, the anterior pair with two broad black bands (i. e. behind stigma and apex of wing), the hind pair black beyond middle.

Male.—Length 12.5 mm.; length of antennae 12.5 mm. Agrees with female, except the fourth abdominal segment is rufo-ferruginous.

Type-locality.—Port of Spain, Trinidad, British West Indies. Described from five females (one type) and one male collected by F. W. Urich, for whom the species is named.

Type.—Cat. No. 19662, U.S.N.M.

ODONTOBRACON OEMEOVORUS, new species.

Female.—Length 8 mm.; length of the ovipositor 2 mm.; length of the antennae 7 mm. Head below the antennae coarsely reticulate, with a poorly defined median carina; head above the antennae and posterior orbits shining, impunctate; no fovea outside of the lateral ocelli; antennae hairy, third and fourth joints subequal; scutum, prescutum, and scutellum shining, practically impunctate; posterior portion of the prescutum with longitudinal carinae, which form two Vs, the posterior one attaining the posterior margin of the scutum; anterior portion of the notauli finely foveolate; suture between the scutum and scutellum with six strong rugae; posterior lateral aspects of the scutellum and the depression of the metanotum with strong rugae; episternauli broad, reticulate; sternauli foveolate; suture and posterior margin of the mesepisternum strongly foveolate; mesepisternum shining; lateral aspects of the pronotum irregularly striato-reticulate; dorsal and lateral aspects of the propodeum reticulate; dorsal middle of the propodeum shining except a median carina along the sides of which are foveolations; first tergite longitudinally striate, the striae more sharply defined medianly and with two predominating carinae on the base, which extend almost to the middle of the tergite; second tergite with an oval median area which is about twice as wide as long, the apical margin of which is not striate, remaining portion of the embossed area strongly striate; sides of the second tergite reticulate; extreme base of the third tergite medianly with fine longitudinal striae; most of the third and all of the following segments shining, impunctate; third, fourth, and fifth tergites at about middle with an indistinct suture; first abscissa on

the radius one-fourth shorter than the second; recurrent vein received two-thirds the length of the first abscissa on the radius, basad of the first transverse cubitus. Black; propodeum dorsally and abdomen rufous; wings dark brown, venation dark brown; body with long, sparse gray hair.

Type-locality.—Florida; Louisiana. Described from one female (type) from Appalachicola, Florida, recorded under Bureau of Entomology No. Hopk. U. S. 3381*g*, which refers to a note stating that this is parasitic on *Oeme rigida*, material collected and reared by W. F. Fiske; and one female (paratype) from Morgan City, Louisiana, recorded under Bureau of Entomology No. Hopk. U. S. 3398*d*, which refers to a note stating that it is a parasite of *Oeme rigida*, material collected and reared by W. F. Fiske.

Type.—Cat. No. 19001, U.S.N.M.

Paratype has the sides of the propodeum rufous.

ODONTOBRACON ELAPHIDIOVORUS, new species.

Female.—Length, 11 mm.; length of ovipositor, 5 mm.; length of antennae, 9.5 mm. Face below the antennae coarsely punctato-reticulate, with a median carina, which becomes broader below; head above the antennae and the entire posterior orbits shining, impunctate; latrad of each lateral ocellus is a curved furrow; antennae hairy, the third and fourth joints subequal; scutum, prescutum, and scutellum shining, with a few widely scattered punctures; the posterior part of prescutum and the scutum medianly reticulate; notauli finely foveolate; suture between the scutum and scutellum with five strong rugae; posterior lateral bases of the scutellum and the depression of the metanotum with rugae; propodeum reticulate, the basal middle without sculpture except a median longitudinal carina; sides of the pronotum with dorsad-ventrad or slightly oblique rugae; the episternauli broad, irregularly reticulate; mesepisternum shining, impunctate; sternauli nearly completely foveolate; sides of the propodeum shining, with well-separated, distinct punctures; first tergite longitudinally striate or striato-reticulate, with two strong carinae, which extend half its length; the second tergite with an oval-shaped embossed area, which is longitudinally striate; sides of the second tergite punctato-reticulate; the base of the third tergite medianly striate, laterally punctato-reticulate; the apex of the third and the folfolwing tergites shining, impunctate; first abscissa on the radius one-third shorter than the second; recurrent vein almost the length of the first abscissa on the radius basad of the first transverse cubitus. Black; body with sparse, long, white hairs; scutellum, propedeum, metothorax, and abdomen rufous; wings brownish, venation pale brown.

Male.—Length, 10 mm. Agrees well with the above characterization of the female.

Type-locality.—United States. Described from three specimens from Texas, one female type, a male allotype, and a female paratype; a single female from Camden, New Jersey, collected June 30; a single female from Jackson, Florida; one specimen from Mount Vernon, Virginia, recorded under Bureau of Entomology No. Hopk. U. S. 11845*d*, which refers to a note stating that this species is parasitic on *Elaphidion vittorum*, material collected by F. C. Craighead, adult emerging February 16, 1914; one female from the Catalina Mountains, Arizona, recorded under Bureau of Entomology No. Hopk. U. S. 12679*a*, which refers to a note indicating that this is a parasite of a species of *Elaphidion* which works in *Quercus emoryi*.

Type.—Cat. No. 19000, U.S.N.M.

ODONTOBRACON CALIFORNICUS, new species.

Female.—Length 7 mm.; length of ovipositor 3.5 mm.; length of antennae 6 mm. Head below the antennae reticulate, with a strong medium carina which is represented immediately above the clypeus by a shining area; head above the antennae and posterior orbits shining, impunctate; behind each lateral ocellus is a small depressed area; antennae hairy, third and fourth joints subequal, oblique apically; scutum, prescutum and scutellum shining, practically impunctate; posterior portion of the prescutum with two longitudinal striae, which attain the apical margin of the scutum; notauli feebly foveolate posteriorly; suture between the scutum and the scutellum with nine rugae; anterior portion of the notauli very finely foveolate; episternauli not sculptured; sternauli foveolate; episternum shining, impunctate, posterior margin foveolate; lateral aspect of the pronotum with oblique rugae ventrally, sparsely reticulate dorsally; lower portion of the lateral aspect of the propodeum shining, sparsely punctured; dorsal aspect and dorsal lateral aspect of the propodeum reticulate; median area reticulate with strong median carina which divides at the top of the posterior face into two poorly defined carinae which extend to the ventral margin of the posterior face; first tergite striate with two prominent carinae basally, which are almost half the length of the tergite and converge apically; second tergite with an oval-shaped median area which is three times as wide as long; sides of the second tergite reticulate; extreme base of the third tergite finely reticulate; most of the third and the entire following segments shining, impunctate; at the apical third of the third and fourth tergites is a transverse furrow; first abscissa of the radius half the length of the second recurrent, about the length of the first abscissa of the radius basad of the first transverse cubitus. Rufous; head, antennae, legs, tegulae, pronotum and a spot on the mesepis-

terum anteriorly; black; body with sparse long gray hairs; wings dark brown, venation the same color.

Male.—Length 5 mm.; length of the antennae 4 mm. Agrees well with the above description of the female except for the abdomen, where the following differences may be noted: First tergite anteriorly is reticulate; the embossed area of the second tergite is one and one-half times as wide as long; the entire third, fourth, and fifth tergites are longitudinally striate and there are no transverse sutures. Color as in female.

Type-locality.—Santa Cruz Mountains, California. Described from one female (type) and three males, one allotype.

Type.—Cat. No. 19002, U.S.N.M.

Superfamily SERPHOIDEA.

POLYGNOTUS BURKEI, new species.

In Ashmead's table to the species of *Polygnotus* this species will go to *diplosidis* Ashmead, from which it may be separated by the distinct furrow from the anterior ocellus.

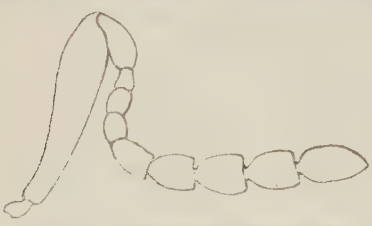


FIG. 1.—POLYGNOTUS BURKEI, NEW SPECIES. ANTENNA OF FEMALE.

Female.—Length 1 mm. Head shing impunctate; vertex finely transversely aciculate; a distinct elongate depression below the anterior ocellus; intraocellar line distinctly shorter than the ocellocular line; pedicellum slightly longer than the two following joints; mesoscutum slightly opaque anteriorly, shining posteriorly; notauli obsolete; mesopleurae shining, without sculpture; metapleurae feebly sculptured; petiole longitudinally striate; base of second tergite longitudinally aciculate, rest of the abdomen shining, without sculpture. Black; four anterior tibiae and tarsi and the posterior tarsi brownish; wings hyaline.

Male.—Length 1 mm. Agrees with the female.

Type-locality.—Placerville. California. Described from four females (one type) and four males (one allotype) recorded under Bureau of Entomology number Hopk. U. S. 12703*a*, which refers to a note stating that this species is parasitic on a Cecidomyid which lives under the bark at the base of the needles of *Pinus ponderosa.* The eggs of the parasite are laid in the eggs of the host, and the adult parasite emerges from the cocoon of the host. Material collected and reared by H. E. Burke, for whom the species is named.

Type.—Cat. No. 19638, U.S.N.M.

Superfamily CHALCIDOIDEA.

TRIGONURA CALIFORNICA, new species.

This species runs directly to *Trigonura* in Ashmead's classification, but differs from Ashmead's description in the 12-jointed antennae and seems to differ from Sichel's description, and figures in the length of the prothorax and the shape of the scutellum. Superficially it resembles closely *Phasgonophora sulcata*, but is immediately separated from that by the absence of a transverse carina and truncation on the first tergite.

Female.—Length 7 mm. Head coarsely reticulate; ocelli in a curved line, the lateral ocelli touching the posterior dorsal margin of the head; interocellar line about one-fifth shorter than the ocellocular line; scape subequal in length with the first three flagellar joints; antennae with a small ring-joint so there are 12 joints, the first two flagellar joint subequal; prothorax sloping anteriorly, the anterior face transversely striato-reticulate medianly; dorsally the prothorax is depressed medianly; thorax coarsely reticulate; the mesopleural fovea striate; lower posterior margin of scutellum with a foveolate furrow; metanotum foveolate; propodeum coarsely reticulate; four anterior femora swollen beyond middle; posterior femora with seven teeth, the basal one the largest; abdomen shining, the first segment subequal in length with the six following, the second to fifth tergite with setignous punctures apically, the sixth with reticulations, the seventh with reticulations basally. Black, clothed with white pubescence; tegulae pale picious; four anterior legs beyond trochanters, posterior legs beyond femora and the seventh segment rufous; the posterior femora basally and the sides of the abdomen are rufopiceous; wings hyaline, dusky beyond middle; venation black.

Male.—Length 6.25 mm. Except for the sexual characters, agrees with the female.

Type-locality.—Placerville, California. Described from four females (one type) and one male (allotype) recorded under Bureau of Entomology number Hopk. U. S. 11611*e*, which refers to a note stating these specimens were reared from sections of willow infested by larvae of *Chrysobothris*, on which they were probably parasitic Material collected and reared by H. E. Burke.

Type.—Cat. No. 19636, U.S.N.M.

EUSANDALUM ACMAEORERAE, new species.

This species may be separated from the other described North American species by the color, by having the posterior margin of the pronotum depressed and less sculptured, and by the arrangement and number of spines on the anterior tibiae.

Female.—Length 1.75 mm. Face reticulate; frontal elevations transversely striato-reticulate; vertex granular; head posteriorly and posterior orbits striato-granular; pronotum reticulate with a tendency to striation; notauli complete; scutum and prescutum reticulate; scutellum more finely reticulate and with a decided tendency to longitudinal striation; prepectus sculptured like the scutum; mesepisternum reticulate, the posterior and ventral part striato-reticulate; mesosternum laterally striate; the upper face of the anterior tibia with six small spines which are widely separated so they begin at the basal third and extend to near apex of tibia; abdomen reticulate. Cupreous with greenish reflections; legs below trochnaters testaceous, the femora, especially the posterior pair, more or less dusky; wings dusky kyaline; venation dark brown.

Type-locality.—Placerville, California. Described from two females (one type), recorded under Bureau of Entomology number Hopk. U. S. 11675*d*. Specimens bred from a pupal cell of *Acmaeodera* in *Ceanothus integerrimus* by H. E. Burke.

Type.—Cat. No. 19637, U.S.N.M.

Superfamily SPHECOIDEA.

Genus DICRANORHINA Shuckard.

Syn.: *Piagetia* RITSEMA.

In the Proceedings of the United States National Museum[1] it is erroneously stated that Turner was in error in reinstating Shuckard's name for this genus. The error was on part of the author and he wishes to apologize for the mistake and for criticising Mr. Turner. The spelling by Hope was *Dicronorhina*, which was amended to *Dicranorrhina*, while the spelling by Shuckard was *Dicranorhina*.

TACHYSPHEX WASHINGTONI, new species.

This species is related to *tenuipunctus* Fox but may be readily separated from that species by the character of the clypeus.

Female.—Length 9 mm. Clypeus convex medianly, the apical margin depressed, medianly with a shallow emargination, sublaterally with two obtuse teeth; the anterior portion of the median convexity shining, impunctate, the basal portion sculptured like the front; front opaque, finely rather sparsely punctured; frontal fovea distinct, complete; intraocellar area convex, parted by a deep furrow; postocellar depression angulate posteriorly and with a deep furrow extending almost to the occiput; head behind the ocelli shining, very sparsely punctured; the distance between the eyes at the vertex slightly greater than the length of the second and third

[1] Vol. 49, 1915, p. 245.

antennal joints, but decidedly shorter than the length of the third and fourth antennal joints; antennae slightly tapering apically, the third joint about one-fourth shorter than the fourth; mesoscutum shining with sparse distinct punctures; scutellum sculptured like the scutum but more finely so, not impressed; mesepisternum shining, reticulate, practically impunctate; mesepimeron sculptured like the mesepisternum; sides of the propodeum finely, longitudinally aciculate; dorsal aspect of the propodeum rather coarsely, uniformly granular, without an impressed line; dorsal and posterior aspects not sharply separated; third cubital on the radius subequal in length with the second on the same vein; legs rather feebly spined, the longer calcaria on the posterior tibiae subequal in length with the posterior basitarsus; pygidium one and one-fourth times as long as the basal width, shining, with a few large, well-separated punctures, truncate apically. Black; the first two abdominal segments except the extreme base of the first rufous; calcaria and spines of the legs ferruginous; wings hyaline, venation ferruginous; head and thorax with dense gray pile; abdominal tergites one to four with narrow apical band of silvery pubescence.

Type-locality.—Grand Coulee, Columbia River, Washington. Described from one female collected July 12, 1902.

Type.—Cat. No. 18995, U.S.N.M.

LARROPSIS GREENEI, new species.

This species is related to *divisa* Patton, but may readily be separated from that species by the sculpture of the dorsal aspect of the propodeum.

Female.—Length 13 mm. Anterior margin of the clypeus rounded medianly, emarginate laterally with two obscure teeth, the outer one larger apically, margin hardly depressed, gently, evenly, convex medianly; the anterior portion of the median convexity shining with large, well-separated punctures; sides of the posterior portion of the median convexity finely, closely punctured; front finely, very closely punctured except the median area from the anterior ocellus to the bases of the antennae which has large, sometimes confluent punctures; intraocellar area uniformly convex, without a median furrow; postocellar depression reduced to a curved furrow; vertex with large, separate punctures; posterior orbits punctured like the front; space between the eyes at the vertex subequal with the length of the second, third, and fourth antennal joints; antennae slender, scarcely tapering apically, longer than the head and thorax; third and fourth joints subequal; anterior face of the pronotum finely granular; scutum so closely punctured as to appear granular; scutellum slightly convex, with a median furrow and with distinct, close, well-defined

punctures; metanotum closely striato-granular; dorsal aspect of the propodeum irregularly transversely reticulate with striae especially prominent in the median area; the base with a short, sharply defined median keel; dorsal middle with a circular fovea which is surrounded by two rings of striation; posterior face oblique with a deep median furrow which is broader posteriorly and transversely striate, dorsally the striae are somewhat oblique tending to meet at the top of the median furrow; sides of the propodeum finely granular, dorsally with a tendency to an oblique aciculation; mesepisternum opaque, finely granular; legs rather feebly spined, the longer calcaria of the posterior tibiae about one-sixth shorter than the posterior basitarsus; third cubital cell on the radius distinctly longer than the second; pygidium sharply defined, about two and one-half times as long as its basal width, with sparse, well-defined punctures apically with a few coarse hairs, the apical margin truncate, angles rounded. Black, the first and second tergites obscurely rufous; wings dark brownish, venation dark brown; body almost without pubescence.

Type-locality.—Riverton, New Jersey. Described from one female collected September 22, 1907, by C. T. Greene, for whom the species is named.

Type.—Cat. No. 18996, U.S.N.M.

It is not unlikely that other specimens of this species will have the abdomen entirely black or that some of them will have the first two segments rufous.

XYLOCELIA BEULAHENSIS, new species.

Close to *nigritus* (Fox) but may be distinguished from that species by the finer sculptured head and by the yellow spot on the tubercles.

Female.—Length 5.25 mm. Clypeus polished, with a few setigerous punctures; the apical margin with three large teeth, the part between the lateral teeth somewhat depressed; supraclypeal area polished; front reticulate and with rather close, well defined, distinct punctures in addition; vertex and posterior orbits reticulate but much more sparsely punctured than the front; ocelli in a low triangle, the postocellar line slightly shorter than the ocellocular line; third antennal joint a very little longer than the fourth; mesoscutum very finely granular, the anterior part with distinct, rather close, well-defined punctures in addition; scutellum shining, nearly impunctate; dorsal aspect of propodeum reticulate, posterior aspect shining, almost without sculpture, a rather large punctiform fovea at dorsal middle of posterior aspect from which a carina extends to abdominal fossa; sides of propodeum shining, almost without sculpture; pygidium rather well defined, one and one-fourth times as long as basal width, granular, with a few irregular punctures basally. Black; posterior half of tubercles yellow; wings hyaline, iridescent, venation dark brown, stigma black.

Type-locality.—Beulah, New Mexico. Described from one female collected by T. D. A. Cockerell in August.

Type.—Cat. No. 18994, U.S.N.M.

XYLOCELIA VIRGINIANA, new species.

In Mickel's key to the species of *Xylocelia* [1] this species runs to *vallicolae salicis* (Rohwer) but it is quite different from that species, being much larger and has the mesoscutum shining. It is something like what the male of *americana* (Packard) would be expected to resemble, but it does not agree sufficiently well with that species to be considered as its male.

Male.—Length 5.5 mm. Anterior margin of the clypeus with a median notch; front opaque, closely granular, with confluent punctures in addition which at first sight give the impression that it is irregularly striato-punctate; vertex shining, sparsely punctured; posterior orbits shining, finely irregularly striato-punctate; ocelli large, in a low triangle; the postocellar line a trifle longer than the ocellocular line; third antennal joint slightly longer than the fourth; eleventh and twelfth joints feebly spined beneath; mesoscutum polished, very sparsely punctured posteriorly but anteriorly the punctures become closer, with four raised longitudinal lines on the posterior part; scutellum shining with a few setigerous punctures and a faint impressed median line; dorsal aspect of the propodeum reticulate, separated from the posterior aspect by a broad foveolate furrow; the posterior aspect coarsely reticulate with a triangular shaped area in the dorsal middle; sides of propodeum coarsely reticulate, stigmatal groove broad and well defined; mesepisternum reticulate anteriorly with a few irregularly raised lines posteriorly; abdomen polished. Black; palpi yellowish white; tibiae and tarsi ferruginous, the tibiae with a dusky spot above; wings hyaline, iridescent, venation dark brown, stigma black; clypeus and supraclypeal area with dense white pubescence; a small yellow spot on the anterior margin of the tegulae.

Type-locality.—Falls Church, Virginia. Described from seven males (one type) collected June 7, 1914, by William Middleton.

Type.—Cat. No. 21397, U.S.N.M.

XYLOCELIA METATHORACICUS MICKEL.

Xylocelia metathoracicus MICKEL, Ann. Ent. Soc. Amer., vol. 9, No. 4, 1916, p. 349.

A series of males and females from St. Louis, Missouri, collected by Mr. Phil Rau extend the distribution of this species.

The male runs to *crassicornis* in Mickel's table and has the antennal joints eight to twelve spinate beneath.

[1] Ann. Ent. Soc. Amer., vol. 9, No. 4, 1916, p. 345.

NYSSON (HYPONYSSON) RAUI, new species.

In both Cresson's and Fox's keys this species goes to *bicolor* Cresson, but the sculpture of the prothorax easily separates it from that species.

Female.—Length 4 mm. Clypeus convex, the apical margin depressed, rounded, the apical part of the convex portion polished, the basal part with large and small punctures; front opaque with close, fine punctures; vertex and posterior orbits more sparsely punctured; postocellar line distinctly shorter than the ocellocular line; the interocellar area not tuberculate; antennae short, stout, not extending beyond the tegulae, the second and third joints subequal in length, the third distinctly longer than the fourth; pronotum rounded, opaque, finely punctured; mesoscutum opaque, the punctures somewhat larger than those of the prothorax; scutellum not margined, punctured like the scutum; metanotum flat, propodeal inclosure longitudinally reticulate; angle of propodeum with a feeble, sharp spine; posterior aspect of propodeum granular, margined laterally and with two feeble longitudinal carinae medianly; sides of propodeum granular; legs rather stout, the longer calcarium of the hind tibiae half as long as the basitarsis; hind basitarsis curved near base; abdomen subopaque with fine close punctures; pygidium well defined and rounded apically, fully twice as long as basal width. Black; mandibles piceous; tubercules and small lateral spots on apical margins of first three tergites whitish, first and side of second abdominal segments rufous; body clothed with dense appressed silvery pile. Wings dusky hyaline, venation black. Third intercubitus wanting; nervellus fully three times its length before cubitella.

Type-locality.—St. Louis, Missouri. Described from one female collected by Phil Rau, for whom the species is named, and sent under his number 2479.

Type.—Cat. No. 21406, U.S.N.M.

Although most authors have suppressed Cresson's name *Hyponysson* the finding of this second species would seem to indicate that it can conveniently be used at least as a subgenus.

SOME EFFECTS OF ENVIRONMENT AND HABIT ON CAPTIVE LIONS.

By N. Hollister,

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INTRODUCTION.

The series of over 100 East African lions now in the collection of the United States National Museum was recently spread out for study. Marked differences between wild-killed specimens and those which had died in the National Zoological Park in Washington were at once apparent. These differences involved both the skins and skulls, and from the fact that five of the park lions were of known history and were from a locality abundantly represented by wild-killed specimens, the uniform differences between the two lots, wild and park-reared, seemed more significant than would otherwise have been the case.

The 11 Zoological Park lions preserved in the collection agree among themselves in all essential details and differ uniformly from wild-killed lions. In the following remarks, however, the notes presented, unless otherwise stated, refer to the restricted subspecies *Felis leo massaica*,[1] represented in the collection by 59 specimens, 54 wild-killed and 5 park-reared. The five park-reared animals have definite and complete records. They were captured near Nairobi, British East Africa, and comparisons of skins and skulls are made with specimens of equal age, killed in the same vicinity. All chance of error from the use of park animals of unknown origin, which might be crosses of different subspecies bred in captivity or specimens of wild forms not represented in the Museum collection, is thus eliminated.

[1] In 1910, when reporting on the mammals collected in British East Africa by John Jay White (Smithsonian Misc. Coll., vol. 56, No. 2, p. 11), I referred the Nairobi lion to *Felis leo sabakiensis* Lönnberg, described from Kilimanjaro. After working over the much more abundant material since received at the Museum I am unable to recognize this race, and now refer these lions to the earlier-named *Felis leo massaica* Neumann, described from Kibaya, German East Africa.

The wild-killed material was collected chiefly by Dr. W. L. Abbott, John Jay White, Col. Theodore Roosevelt, Kermit Roosevelt, Paul J. Rainey, and Edmund Heller.

The histories of the five Zoological Park specimens of *Felis leo massaica* have been given me by Mr. A. B. Baker, assistant superintendent of the National Zoological Park. It seems important to give his account in complete detail.

The history of the five lions from East Africa, so far as we know it, is as follows:

In May, 1909, while the Smithsonian expedition was at Nairobi, Mr. W. N. McMillan offered the lions and several other animals to the National Zoological Park, through Dr. E. A. Mearns, who reported the offer here by letter. He was authorized by cable to accept the animals on behalf of the park.

I first saw the lions September 19, 1909. They were then at Mr. McMillan's "Juja Farm," some 23 miles northeast from Nairobi. There were two males, said to be then about 20 months old, and three females, one of which was said to be about 19 months old and the other two about 27 months. All were said to be from the region about the Nairobi, but I was able to get the exact locality of only one—a male which was captured by Mr. G. L. Langridge in the Mua Hills, out some 25 miles from Machakos station. When captured it was a little larger than a house cat. I was told that all of the others were caught while small cubs. The lions were put into shipping boxes October 15 and 16, left Juja Farm on a big freighting wagon at noon October 18, and arrived at Nairobi late on the 19th. The boxes were put under a shed in the railroad freight yard there until the morning of October 26, when they were shipped by rail, and should have reached Mombasa early in the morning of the 27th, but did not arrive there until noon of the 28th, because of the derailing of the train, which made it necessary to transfer all the boxes to other cars. They were transferred to the steamship *Melbourne* shortly after noon on the 28th and arrived at Port Said at 8 p. m. November 8. They were kept on a lighter in the harbor there until November 21, when they were transferred to the "tramp" steamer *Moltkefels* sailing that day. The ship spent the night of November 25–26 at Malta, and arrived at Philadelphia December 17. The lions were forwarded from Philadelphia December 18, reached Washington early on the 19th, and were transferred to cages in the lion house at the park about noon of that day.

At Juja Farm the five lions were kept together in a stone building, perhaps 25 feet long, 15 feet from front to back, and 8 feet high. This was divided by a partition running from front to back, into two compartments, perhaps 15 and 10 feet wide. The roof was of galvanized iron. The floor was of concrete, with good drainage so that it could be washed out with a hose. All sides were tight, except the front, which was closed with an iron grating. The place was poorly lighted and the animals had little chance to get into the direct sunlight. There were low wooden shelves in the corners, which the animals seemed to occupy most of the time when not walking. The three younger lions were good tempered, but the two older females were quite savage, probably from having been teased. The shipping crates were about 3 feet wide, 5 feet long from front to back, and 3 feet 6 inches high, inside measurements. There was a steel grating in the front, with stout wire netting over it, so that a paw could not be put out. A space was left at the bottom wide enough to admit food and pan for water. This space was closed except when food or water was given. There was a ventilating opening, about 8 inches square, in the

rear end of the box fitted with a grating. This opening was covered over when the animals were shipped from Port Said to protect them from the colder weather that would come during the remainder of the journey. At the park the lions were put into cages 10 feet wide, 8 feet deep from front to back, and 7 feet high. They were kept in these for about two years and then transferred to cages 12 feet 6 inches wide, 12 feet deep from front to back, and 9 feet high. These latter cages connect with outdoor cages 20 feet wide, 33 feet deep from front to back, and 10 feet high. The lions had free access to these outside cages during the day, whenever the weather was suitable.

While they were at Juja Farm the lions were fed mainly on zebra and kongoni (*Coke's hartebeest*), which usually were to be had for the shooting within a mile of the house. The whole dressed carcass was used and the lions were given sections from any part of it. They were liberally fed and apparently had a fair proportion of bone with the meat. I gave them zebra meat till October 20, then beef, mostly neck and shoulder, till November 1. Owing to an accident on the railroad it was impossible to give them either food or water from 6 a. m. of October 26 to noon of October 28, although during the first day they were exposed to the hot sun on an open car. From November 3 to 7, three sheep, bought at Djibouti, were fed them. November 9 to 22 they had beef, and the 23d and 24th a goat each day. From November 26 to 30 beef from Malta was fed. This was hind quarter, largely "round," as I found that beef from any part of the body was priced the same, and hind quarter gave the most meat for the money. From December 1 to 16 the lions were fed on goat meat, one goat being butchered each day, or one every second day, as the supply dwindled. From December 17 they were fed on beef. At the park the lions were given cuts of beef from brisket, shoulder blade, and short ribs, with, occasionally, upper shin or shoulder cut. At first they were given 8 pounds daily, which was increased, as they grew, to 10, 12, and finally a maximum of 14 pounds during the winter months to the two males. Most of this was cold-storage beef, and occasionally it was necessary to use some that had been frozen.

All of the lions appeared to be in perfect health when shipped and when they reached the park, except that the male (No. 2297) had a small abscess in one cheek, and that all were infested with roundworm and tapeworm. The tapeworm was probably acquired from the kongoni, the meat of which I was told is generally "measly."

The male lion No. 2297 (U.S.N.M., No. 197944) died March 1, 1914, of chronic gastroenteritis. He had been ill for about 10 months, could not properly digest his food, and was emaciated. He became blind about 18 months after his arrival at the park and remained so for about three months, then began to recover his sight, the pupil, which had been fully expanded, gradually contracting as the eye responded to the light.[1]

Male No. 2367 (U.S.N.M., No. 199707) was shot July 1, 1915, as he was unfit for exhibition. Autopsy showed considerable softening at the base of the brain, but other organs appeared to be practically normal. This lion became blind about 15 months after arrival and did not regain sight. The effects of the brain lesion were first noticed about two years before death and increased until the animal was finally killed. He always ate well and was in good flesh.

Female No. 2209 (U.S.N.M., No. 176201) died March 22, 1913, from choking. She was a hasty eater, bolting her food, and this time a large piece of meat lodged in her throat and she died before help could be given. She kept in

[1] This is the only skull among the five which shows pathological conditions in the bone. The shape and general characters of the skull are exactly as in the others, but the bone is very light and flaky.—N. H.

excellent flesh, although fed only 10 pounds of beef, but sometimes, after bolting her own portion, she would rob another lioness of part of its food. She was heavily infested with ascaris worms. She was the youngest of the three lionesses. She was bred several times, but never became pregnant.

Female No. 2276 (U.S.N.M., No. 197137) was shot December 25, 1913, as she was unfit for exhibition. In November, 1912, she was removed to a hospital cage on account of her difficulty in walking. She ate well and remained in excellent flesh, but the trouble continued to increase until she was killed. The autopsy did not show any serious lesions. She was given but 10 pounds of beef per day. She came in heat several times, but would not allow the male to approach her.

Female No. 2360 (U.S.N.M., No. 199524) died of pericarditis February 14, 1915, about six weeks after the first symptoms of illness were noticed. She was the largest of the lionesses, and her daily ration was 11 pounds of beef. She was bred several times, but did not become pregnant.

Not knowing just what data you might want, I have given the history with much detail.

The conspicuous external characteristics which distinguish these McMillan lions (as the five park-reared specimens will hereafter be called) from wild-killed animals of the same age and from the same region are much darker color, more luxuriant mane, and much longer hair tufts on back of elbows. The skulls are very different in general proportions. Those of the McMillan lions are much shorter and broader than in wild animals; their zygomatic arches are more wide-spreading, and the bones of the arches are much thicker and more cylindrical. (See pls. 22–25.) These skulls have furthermore a greater rostral and mastoid breadth and numerous minor distinguishing characters. Only one of the McMillan skulls shows evidence through pathological changes of the life in captivity, and this condition has affected the quality of the bone and not the shape, as the skull agrees in all the relative dimensions with those of other park lions in perfect condition.

COMPARISON OF McMILLAN LIONS WITH WILD-KILLED SPECIMENS FROM VICINITY OF NAIROBI.

Color and External Characteristics.

At the time of their arrival in Washington the McMillan lions were the subject of remark on account of their exceedingly pale coloration. Most of us had been accustomed to the much darker park lions, usually seen in captivity, and these new arrivals seemed particularly beautiful animals because of the strange pale grayish buff coloration, which was, as a matter of fact, the normal coloration of the subspecies to which they belonged. When, after the death of the animals, the skins reached the museum, the great darkening of the general color since their arrival was at once noted. The degree of color change is in direct relation to the period of life in Washington. In the following notes on color the skins have been

observed from in front; they present a somewhat darker aspect when viewed from the rear.

Males.—Wild-killed adult males of *Felis leo massaica* are all of a very uniform color. The general appearance is that of grayish buff animal, a very light-colored lion with virtually no deep ochraceous or dark brown in the hue of the skin. The general body color is the effect of pinkish buff hairs tipped with blackish, the dark tips considerably grizzling the otherwise general pure buff coloration. The hairs of the belly, throat, and insides of limbs lack the black tips and these parts are, as a consequence, almost pure pinkish buff in color. The tufts at the back of the elbows are comparatively short, mixed buff and brown. The mane varies greatly in different animals, but averages much shorter than in captive lions, is rather coarse haired, and comparatively light in color. It is produced on the withers in a narrow line and is almost entirely wanting on the shoulders. The tail is more gray, less buff than the body, but lacks any suggestion of ochraceous.

The first male McMillan lion to die in the park was No. 197944, March 1, 1914. He had been in Washington a little over four years and was, according to Mr. Baker's records, about six years of age at the time of death. The skull shows a fully adult animal with basisphenoid suture obliterated and with a fully developed sagittal crest. The skin is considerably darker, more ochraceous buff or cinnamon buff, than in wild-killed males of the same age. The general color of the back is more cinnamon buff; the black hair tips, though present, are less conspicuous against the darker ground color and the general appearance is therefore less grizzled, more reddish. The belly, throat, and inner sides of limbs are decidedly pinkish cinnamon instead of pinkish buff, as in all wild-killed males. The tufts at the back of elbows are long, luxuriant, and silky, mixed deep black and buff—much longer and fuller than in any wild-killed animal. There is a supplemental tuft of dark brown hair on each side of the lower belly. The mane is longer, more silky, and more cinnamon buff in color than in wild-killed lions. It extends far back on the withers and laterally onto the foreparts of the shoulders in curly masses. The tail is decidedly more ochraceous and black, instead of buff and blackish as normal in the subspecies.

The second male McMillan lion (No. 199707) died in the Zoo July 1, 1915, at an age of about seven and one-half years, five and one-half years of which had been spent in Washington. The skin of this lion is decidedly darker than any other East African specimen. The appearance of the animal has been greatly changed—from a pale grayish buff to a dark brownish ochraceous. The general color of the upper parts and sides of the body is dark tawny olive; of the belly, throat, and insides of limbs cinnamon to pale ochraceous tawny. The

tufts at backs of elbows are extraordinarily long, thick, and silky of rich black and buff hairs. Whereas in wild lions of equal age the hairs of these tufts average about 60 millimeters in length and are rarely over 80, in this specimen they are 200 millimeters in length. The mane is remarkably full and is not approached in this respect nor in its deep coloration by those of wild-killed lions. It is full and wide on the withers and luxuriant on the lower neck and anterior shoulders. The whole head, face, and mane are richly tinged with deep tawny and ochraceous. The tail is rich and dark in color, the black tip offering little contrast in shade from the general color of its upper side.

Females.—The wild lioness of *Felis leo massaica* averages somewhat darker in color than the male, but the coloration in its essential elements is the same—a grayish buff general color, the effect of a pale pinkish buff ground color mixed with the blackish of the hair tips. Except in very rare cases there is little or no indication of real tawny or ochraceous in the general coloration.

The first of the three McMillan lionesses to die was No. 176201, March 22, 1913. The skin is much darker than the average wild-killed *massaica* and is very much darker than when the animal reached the Washington Zoo in 1909.

The second female (No. 197137) died December 25, 1913. The skin of this lioness is somewhat darker than the wild animal and is conspicuously cinnamon colored, not at all the grayish buff of a normal *massaica*. The belly is pure cinnamon color, not buff as in all the wild lionesses of this form. The coat is long and full.

The last female of the McMillan lions died February 14, 1915, after over five years in the Washington Zoo. The skin is very dark and has been greatly changed since its arrival. It is very much darker than any skin of a wild-killed female *massaica* in a large series, and at a short distance looks like a tawny blackish animal. It represents the extreme of change in color in the lioness as No. 199707 does in the lion. The back is dark brownish tawny olive, rich and glossy.

From the above facts it is evident that life in Washington considerably darkened the color of these McMillan lions. Young wild lions are much darker and richer colored than adults, quite the reverse of the condition in the McMillan lions. From Mr. Baker's notes it is seen that while the captive lions were kept during their stay in Africa in a virtually sunless and rather dark den, in Washington they had abundant access to out-of-doors yards. In view of the success of Mr. Beebe's experiments in increasing the pigmentation in birds by confinement in superhumid atmosphere,[1] it would

[1] Zoologica, vol. 1, No. 1. New York, 1907.

perhaps seem unnecessary to go beyond the theory that the humid climate of Washington has acted in a similar manner on these lions from the highlands of East Africa. The effect has been to change the color of living examples of *Felis leo massaica* to a darker color very much resembling that of *Felis leo nyanzæ*, the lion of the more humid Victoria Nyanza region.

While the data available do not show very great difference in mean relative humidity between the weather station at Machakos, British East Africa (near where the lions were captured), and Washington, District of Columbia, the average monthly precipitation at Washington for a term of years is considerably greater. At Entebbe, Uganda (near the type-locality of *Felis leo nyanzæ*), both mean relative humidity and monthly precipitation are higher than in Washington or in the British East African range of *Felis leo massaica*. The problem is so complex and there are so many possible factors which are little understood, that it seems unwise to hazard a positive opinion on the cause of the great color change in the McMillan lions. Alterations in the quality of light to which the animals were exposed, as well as the changes in the conditions of metabolism due to a life in captivity under abnormal treatment and diet, are factors that must be considered.

Mr. F. C. Selous,[1] after writing of the variability of the mane in lions apparently adult, says:

> Quite recently there was a fine lion in the Zoological Society's Gardens at Regent's Park which was presented by Messrs. Grogan and Sharpe. This animal was caught near the Pungwe River, in southeast Africa, and brought to England by these gentlemen when quite a small cub. When full grown it developed a very much finer mane than I believe has ever been seen in a wild lion that has come to maturity in the part of Africa from which it was brought. Similarly, some 30 years ago there was a very fine lion in the Society's Gardens which was brought by Colonel Knox from the Soudan. Colonel Knox took me to the Gardens to see this animal, and pointed out to me the fact that it had developed a far finer mane (extending much farther back over the shoulders and under the belly) than any man had ever seen in a wild lion in the country from which it came. Lion cubs brought to this country from India also grow fine manes, though I do not think that there is any record of a lion ever having been shot in India with anything more than a fairly good mane. The fact that lion cubs captured in any part of Africa or Asia, and brought up in the comparatively cool and damp climate of western Europe, always—or nearly always—grow fine manes, which usually cover the whole shoulders and often extend all over the undersurface of the body, and the further fact that in the hotter parts of Africa lions always have very scanty manes, but on the high, cold plateaus often develop good, and occasionally very luxuriant manes, appears to me to show that a heavily maned lion is a reversion to an ancient ancestral type, first evolved in Pleistocene times in a cold and inclement climate.

[1] African Nature Notes and Reminiscences, pp. 83, 84. 1908.

Mr. Selous has noted that while the eyes of wild lions are of a "flaming yellow" in color, those of animals reared in captivity are often brownish.

Skull Characteristics.

The greatest interest in the study of the McMillan lions compared with wild examples from the same region lies in the skull. The skulls of the captive animals are of a definite, uniform shape and differ from all the skulls of wild-killed lions in the Museum collection in a number of conspicuous characters. They are broader and shorter, more massive and bulky, and exhibit abundant relative differences which would be instantly accepted as of "specific" value in wild animals. The obvious reason for these great differences is that the principal muscles operating the jaws and neck (those muscles used by a wild lion in mauling and killing game, biting, gripping, and shaking) have had little influence on the shape of the bones during development. In a wild-reared lion these powerful muscles naturally and in a normal way mold the growing skull, particularly in the regions of their attachment.

The most conspicuous peculiarities of the McMillan lion skulls are the greater (relative and actual) zygomatic breadth, the large rostra, and the great distance across the base of the skull at the mastoids. While actually measuring less in condylobasal or greatest length than many of the wild *massaica* skulls of equal age, they have a far greater zygomatic breadth than any, averaging about 30 millimeters more in males and 20 millimeters more in females. (See detailed measurements, p. 192; and pl. 24.)

All five of the McMillan lions, male and female, are, as already noted, fully adult, the skulls with basal sutures obliterated. All agree in most particulars in the differentiating characteristics, and comparisons may be made with wild-killed skulls of *Felis leo massaica* from the same vicinity and of equal age, without special designation of specimens by number. The differences are sometimes most pronounced in males.

Regions of attachment of the masseter muscle.—Contrary to the usual textbook definition of its function, the masseter muscle unquestionably furnishes the chief gripping power; it is the one most exercised during use of the canine and incisor teeth.[1] Aided by the

[1] In this connection see Keith, The Antiquity of Man, 1915, pp. 462–463. The lion, like all cats, is a biting animal of the highest type. While there is intimate relationship between the functions of the masseter and temporal muscles, and the two masses are actually connected, each nevertheless is the prime power in the definite mechanical action of separate parts of the dental row. The masseter, as stated above, has primarily to do with the front teeth (the canines and incisors), while the temporal is chiefly concerned with the molar-premolar row, and the process of cutting and chewing rather than biting and gripping.

temporal and internal pterygoid muscles, it locks the jaw and makes the grip firm. The region of its origin in the McMillan skulls is greatly changed from the wild type. The malar and the zygomatic process of the temporal bone[1] have been almost uninfluenced by the muscle and have to a certain degree retained distinctive characters of juvenility. In wild lions this muscle has exercised very great influence on the bones of the zygomatic arch. The following characters, which appear to be largely due to the nonaction of this muscle, separate easily the McMillan lion skulls of either sex from wild skulls of equal age: Zygoma more spreading anteriorly; malar very thick and wide; squamosal arm subterete and heavy, almost rounded in cross section and not at all concave on inner surface, with no superior margin for strong muscle attachment [in skulls of wild-killed specimens the squamosal arm of the zygoma is thin and light, but strong; it is greatly hollowed out on inner surface and has a sharp superior margin]. The region of insertion, the outer lateral face of the ascending mandibular ramus, is also greatly modified. In the McMillan skulls it is comparatively heavy and thick, but is smooth and poorly fitted for muscle attachment. The margin is smooth and rounded. The great zygomatic breadth of the skull of the captive lion is partly due to the rounded squamosal arm.

FIGS. 1–2.—CROSS SECTIONS OF ZYGOMATA OF WILD-KILLED AND PARK-REARED LION SKULLS, MADE AT INFERIOR POINT OF ZYGOMATICO-TEMPORAL SUTURE.—(1) WILD-KILLED (No. 155443, NAIROBI, BRITISH EAST AFRICA); (2) PARK-REARED (No. 199707, "McMILLAN LION.") ADULT MALES OF EQUAL AGE. NAT. SIZE.

Some measurements of two old adult male skulls of equal age are as follows:

	Wild lion (from Nairobi (No. 155443).	McMillan lion (No. 199707).
	Mm.	*Mm.*
Condylobasal length	335	325
Zygomatic breadth	234	264
Greatest thickness of zygoma at middle	9.3	14.8
Actual thickness of bone at middle of zygoma	4.0	11.5
Thickness at inferior zygomatico-temporal suture	14.4	29.1
Height of arch at middle, across malar and zygomatic process of temporal	31.9	36.9

[1] The masseter is attached to almost the entire length of the inner side of the zygoma, from just back of the molar tooth to the pit on the upper side of the squamosal root, and to the ventral half of the outer surface from near the maxillary tuberosity to near the glenoid surface.

Regions of attachment of the temporal muscle.—The temporal muscles, chiefly concerned with the cheek teeth rather than with the front teeth,[1] have had less influence in changing the type of skull of the captive lion, than have the masseters. The lion in captivity has, as a matter of fact, used his temporal muscles in much the normal way of a wild lion, whereas the natural function of the masseter is almost entirely discontinued in a captive animal which does not kill its own prey. As a precaution against the natural tendency of the animals to bolt their food without mastication, the lions in the Zoological Park are regularly fed pieces of meat with large bones.

The region of origin, the entire side of the skull posteriorly, is somewhat modified. The brain case has been less subjected to pressure by these powerful muscles than in the wild lion; the muscles have had less to do with moulding its shape during the process of absorption and ossification; and it, as a consequence, is less compressed laterally. Wild lion skulls of equal age have smaller braincases, more sharply marked sagittal and lambdoidal crests. The region of insertion, the inner surface of the ascending ramus, is slightly smoother in the McMillan lions, but is little modified.

Capacity of the braincase.—As stated above, external measurements of the braincase in wild lions are less than in park-reared animals of equal age. The capacity of the braincase, however, is considerably greater. Young adults of each, as usual among carnivores, have greater braincase capacity than old or aged adults. The bones forming the cranium of the Zoo lion are thicker, and the actual size of the brain is less than in wild-killed examples. In the case of the McMillan lions the capacity is about 50 cubic centimeters less in males and about 40 less in females, than in wild-killed examples of equal age from the same locality.

The "Richardson lion," from the New York Zoological Park, celebrated as the record skull for greatest breadth,[2] and the Menelik lion, the type-specimen of *Felis leo roosevelti*, are both park-reared animals of uncertain history but they show the skull characters of captive lions to a marked degree. Even the skulls of these enormous lions, although the animals represent forms unquestionably larger in a wild state than *Felis leo massaica*, have less braincase capacity than any wild-killed examples of the East African lion.

[1] A fox skull, in the Vienna Museum, with a defective left lower carnassial tooth, exhibits an asymmetrical condition because the animal used its right temporal muscle to such a degree as to develop this muscle far above the normal strength, while the left temporal muscle was very weak from little use. The right temporal ridge on the skull was pushed up almost to the sagittal line while the left temporal ridge remained below its normal elevation for that age. The occipital crest is likewise asymmetrical. (Toldt, Zool. Anz., vol. 39, pp. 176–191, figs. 1–4. July 4, 1905.)

[2] See Roosevelt and Heller, Life-Histories of African Game Animals, vol. 1, 1914, p. 225.

Following are some measurements of the capacity of the brain-case in fully adult lions:

MALES.

	No.			Cc.
Wild-killed	155443	*Felis leo massaica*	Nairobi	265
Do	182297	do	Kapiti	265
Do	182332	do	do	285
Park-reared	[1] 199707	do	Nairobi	215
Do	[1] 197944	do	do	220
Do	38246	"Richardson lion"		250
Do	144054	"Menelik lion"	[Abyssinia]	255

FEMALES.

Wild-killed	182309	*Felis leo massaica*	Ulu	245
Do	182326	do	Kapiti	255
Do	182421	do	do	245
Park-reared	[1] 197137	do	Nairobi	190
Do	[1] 199524	do	do	215

[1] McMillan lions. These are the only park-reared skulls strictly comparable with wild-killed *F. l. massaica.*

The mastoid and occipital regions.—These regions are, except for the squamosal arm of the zygoma, the most modified parts of the park-reared lion skulls. The change from the uniform type found in the wild lion is very great. The mastoid breadth in the McMillan lions is far greater than is usual in wild skulls of equal age; the mastoids are broad and spreading, with the large, smooth, postero-external surfaces next to the paroccipital process only slightly turned forward from the general occipital plane, and without sharply marked marginal ridges [in wild lions the mastoid breadth is usually much less, the sides are drawn in and forward, so that the postero-external surfaces of the mastoids lie in a position at a much greater angle from the general occipital plane; marginal ridges sharply recurved; paroccipital process longer and more angular]. (See pl. 25.)

Nondevelopment of the muscles chiefly used in lifting and shaking prey and the consequent lack of necessity for strong attachments is clearly responsible for this difference in the park-reared animals. The splenius, complexus, rhomboideus capitis, cleido-mastoid, sterno mastoid, rectus capitis posticus major, and rectus capitis posticus minor all attach to the affected parts. A powerful splenius is necessary in the wild lion, as the beast commonly carries heavy prey for long distances; the well-developed rhomboideus capitis aids in this work. The complexus and mastoid muscles are of great power in the shaking process and are, like the splenius and other closely related

muscles, naturally less developed in the animal reared in captivity. The digastric muscle, of quite another function, but powerfully developed in the cat, and having its origin on the paroccipital process and inward, bordering the posterior margin of the auditory bullæ, is no doubt somewhat responsible for the development of shape in this part of the skull as well. After a preliminary movement of the hyoid muscles, it is the chief agent for depressing the jaw. The cephalo-humeral and other muscles and the ligamentum nuchæ attach to the base of the skull but, in this problem, are of little importance.

The mastoid breadth in a wild-killed adult male lion from Nairobi (No. 155443) is 135 millimeters; in a McMillan lion of the same age (No. 199707) it is 152.

The lambdoidal ridge and occipital bones are broader in the McMillan skulls than in any skulls of wild lions. Here again the splenius and complexus muscles, through nondevelopment, have failed to influence the bone as in a normal wild lion whose life is one of tearing and shaking of strong prey.

The development of powerful neck muscles evidently begins in the wild lion at an early age. Roosevelt and Heller write of the young lion:[1]

> When the cubs are three months or so old, they habitually travel with the mother; then, instead of eating her fill at a kill and afterward returning to the cubs, the latter run up to the kill and feed at it with their mother. We found flesh and hair in the stomachs of two cubs; for they begin to eat flesh long before they stop suckling. While still very young they try, in clumsy fashion, to kill birds and small animals. By the time they are four or five months old they sometimes endeavor to assist the mother when she has pulled down some game which is not formidable, but has not killed it outright before they come up; and soon afterward they begin to try regularly to help her in killing, and they speedily begin to help her in hunting and to attempt to hunt for themselves. Evidently in their first attempts they claw and bite their prey everywhere; for we found carcasses of zebra and hartebeest thus killed by family parties which were scarred all over.

Remarks on Other Park-Reared Carnivores.

Park lions in the museum collection recorded as from Abyssinia, Sudan, and Somaliland, and others without definite history, agree in all essential details with the McMillan animals. The Menelik lion, which has been made the type-specimen of a new subspecies,[2] is virtually inseparable by any character, so far as the skull is concerned, from the McMillan lions. The differentiating characters as given in the description are exactly those separating park-reared from wild-killed specimens of the East African *massaica;* the specimen was compared with wild examples. This animal was presented

[1] Life-Histories of African Game Animals, vol. 1, 1914, pp. 165, 166.

[2] *Felis leo roosevelti* Heller, Smithsonian Misc. Coll., vol. 61, No. 19, p. 2. November 8, 1913.

to President Roosevelt by Emperor Menelik of Abyssinia and died in the Washington Zoo. All the characters of skin and skull point to a life-long captivity. The skin shows a long, full mane which connects from the neck with the elbow tuft. The colors are almost exactly as in the McMillan male longest in captivity, except that the mane is slightly darker and is curly instead of straight haired. Black manes and curly manes are individual variations found in males of equal age from one locality. One male *massaica* collected by Dr. W. L. Abbott has a much blacker mane than the Menelik lion.

An old male lion from Sir Francis Reginald Wingate, Omdurman, Sudan, which died in the Washington Zoo, is of the same type and shows all the characteristic evidence of a long life in captivity. The mane extends in a curly mass from the withers on to the shoulders, but does not connect between the neck and elbow tuft; it is largely black. This skin exhibits small tufts of hair on each side of the lower belly, like the McMillan male number 197944.

In a large series of leopard skulls in the collection a single specimen is from a park-reared animal. It can instantly be selected from the series by a blindfolded person familiar with the characteristic shape of the bone in the zygomatic arch of the McMillan lions. Wolves born and reared in the Washington Zoo from parents of known history show the same characteristic shapes of these bones when compared with wild-killed animals of the same subspecies. The differences are much less in the wolf, however, than in the great cats.

No changes in the teeth have been noted in the park-reared animals of any species, although the teeth of the McMillan lions do actually average slightly less in size than in wild-killed animals. The variation, shown in the following table, is so slight as to be of little consequence without further data:

Dental measurements of adult Felis leo massaica.

Locality.	Number.	Alveolar length of upper canine.	Upper carnassial.	Second upper premolar.	Lower molar.
Wild-killed males.					
		mm.	*mm.*	*mm.*	*mm.*
Kapiti Station	182297	27.8	40.0 × 19.9	27.5 × 13.5	28.6 × 15.3
Do	182332	26.5	37.8 × 19.2	27.2 × 13.7	28.7 × 14.5
Ulu Station	182307	24.5	37.8 × 18.8	26.7 × 13.9	28.5 × 14.2
Ulukenia Hills	182313	26.9	41.5 × 21.1	28.5 × 15.4	28.9 × 15.3
Nairobi	155443	27.8	39.3 × 18.9	27.3 × 14.0	28.8 × 14.5
Laikipia Plateau	163328	24.4	38.0 × 19.1	27.3 × 12.1	27.7 × 13.6
McMillan males.					
	197944	23.0	35.8 × 18.1	24.0 × 13.4	28.2 × 13.9
	199707	25.2	37.9 × 19.7	25.8 × 13.0	27.6 × 14.7

Dental measurements of adult Felis leo massaica—Continued.

Locality.	Number.	Alveolar length of upper canine.	Upper carnassial.	Second upper premolar.	Lower molar.
Wild-killed females.		mm.	mm.	mm.	mm.
Ulu Station	182308	23.6	35.4×17.7	23.8×11.7	25.1×12.7
Do	182309	24.9	38.5×19.4	27.7×14.1	28.4×14.6
Do	182311	20.7	33.6×15.9	22.3×11.5	24.6×13.2
Kapiti Station	182293	21.9	35.2×17.1	23.7×12.9	25.3×13.9
Do	182324	20.9	33.9×16.8	23.6×11.7	25.3×12.4
Do	182326	19.4	33.2×15.5	22.1×11.2	23.9×12.1
Do	182421	21.9	32.5×16.3	23.1×12.2	23.3×12.7
Do	182423	21.2	33.1×17.0	21.8×12.5	24.6×13.6
Wami Hill	161914	21.7	33.4×15.6	21.7×11.1	24.2×12.1
Kitanga	182315	23.2	35.6×16.5	22.2×12.0	25.6×13.2
McMillan females.					
	197137	19.1	33.6×15.2	22.9×10.5	23.8×11.9
	199524	19.2	32.5×15.4	21.7×11.3	22.9×12.4

SUMMARY.

Specimens of the exceedingly pale *Felis leo massaica* brought from the British East African highlands to Washington change from the normal pale grayish buff color of the race to a darker color, resembling that of *Felis leo nyanzæ* of the Victoria Nyanza region. The color deepens with each successive moult for five years at least. The cause of this color change is unknown, though humidity is probably a factor of some importance.

The skulls of lions and other large carnivores which habitually kill quantities of heavy game are greatly influenced in a definite way by the development of the principal muscles used in gripping, holding, tearing, biting, and shaking. If the animals are captured when young and reared in confinement these particular muscles are little developed and the bone at the region of origin or insertion is little changed by their influence. The bones then retain certain characteristics of juvenility and develop along wholly different but uniform lines from that of the wild-reared animal.

Changes in the skull which would be accepted as of "specific" or possibly of "generic" value in wild animals from different regions are thus produced in the life of a single individual within from five to seven or eight years, almost as rapidly as if by "mutation."

The primary object of this paper is to call attention to a definite case of structural modification by habit.[1] No idea of extensive specu-

[1] The value of evidence derived from this case over that furnished by experimental mutilation of young animals can easily be appreciated. Nevertheless experiments such as those recorded by Anthony and others, like the removal of the greater part of the

lation on its meaning or the possible value of the records in the study of evolution is contemplated. The opportunity for such speculation, however, is unlimited, and the temptation is great. This remarkable change has taken place in the lions under artificial treatment. Might some such a change not happen in a state of nature? At numerous times in geologic history whole groups of animals have become extinct. In fact, this is the rule, and only a few of the types known from fossil remains have left living descendants. If all the ungulate mammals of Africa or in some one extensive region were swept away in a few years by a plague like the rinderpest, would the lion die out, or would he completely change his habits in one generation and become a feeder on mice, squirrels, birds, and fruit? In the latter case, would not the enforced disuse of the powerful mechanism for the destruction of zebras, hartebeest, and larger game produce in one generation, as with the park lions, a type of skull wholly different from that now known in a state of nature?

One can easily believe that if the ordinary wild lion skulls were known only from Miocene deposits and the specimens were compared with the McMillan lion skulls, they might be regarded as representing the ancestor of the latter. The great change would naturally be regarded as the result of slow variation continued over that long period of time.

The use of zoological park material in the description of new forms of mammals should be discouraged. New names should never be based on animals in parks or on skins and skulls of specimens which have lived long in captivity.

Relative dimensions (ratio of length to breadth) of skulls is shown by the McMillan lions to be easily changed by habit or environment. Great weight has often been placed on the ratio of length to breadth, as a deep-seated character. Paleontologists, especially, value such differences much higher than do workers in recent mammals who have access to large series of closely related subspecies and are familiar with the variations they exhibit in this respect. The surprising and uniform differences in this regard between the McMillan lion skulls and the skulls of wild-reared examples of *Felis leo massaica* are, nevertheless, a revelation to all mammalogists who have seen the specimens.

left temporal muscle of a puppy at birth and the subsequent dissection of the animal at or near maturity, have shown the importance of the study of the action and growth of the muscles, exercised by peculiar habit, in the formation of species. (See especially Anthony, Bull. Sci. Anthr. Paris, ser. 5, vol. 4, 1903, pp. 119–145, figs. 1–11. Anthony and Pietkiewicz, C. R. Acad. Sci., vol. 149, 1909, p. 870, and other papers by the same authors.)

Measurements of skulls of lions.

MALES.

Locality or history.	No.	Condylobasal length.	Greatest length.	Zygomatic breadth.	Mastoid breadth.	Interorbital constriction.	Greatest thickness of zygoma at middle.	Actual thickness of bone at middle of zygoma.	Thickness at inferior malar-squamosal suture.	Height of arch at middle.	Breadth of brain case.	Length of mandible.
Wild-killed massaica.												
Kapiti Station	182297	322	373	248	135	71	8.6	8.0	15.8	35.8	112	257
Do	182332	328	372	228	138	70	7.3	5.5	11.2	30.0	111	253
Ulu Station	182307	324	....	230	142	71	8.7	6.5	14.2	31.3	....	249
Ulukenia Hills	182313	....	....	236	....	72	7.9	7.0	12.2	29.5	....	244
Nairobi	155443	335	373	234	135	70	9.3	4.0	14.4	31.9	107	256
Laikipia	163328	316	337	233	133	75	8.2	6.0	16.0	33.2	108	235
Park-reared.												
"McMillan lion"	197944	309	345	261	146	78	12.4	10.5	25.7	31.4	116	248
Do	199707	325	363	264	152	80	14.8	11.5	29.1	36.9	120	260
"Richardson lion"[1]	38246	332	366	277	139	75	13.0	12.5	20.5	30.8	124	248
"Menelik lion"[2]	144054	296	335	255	132	70	20.5	18.1	24.2	29.4	117	236
"Abyssinian lion"[3]	174639	308	333	246	128	71	12.3	11.5	27.2	31.6	112	233

FEMALES.

Wild-killed massaica.												
Kapiti Station	182293	264	294	203	120	63	7.4	4.0	10.8	25.6	....	203
Do	182324	266	299	185	111	57	7.2	4.0	9.7	26.8	94	200
Do	182326	267	299	204	117	60	7.7	3.0	9.2	29.3	99	210
Do	182421	262	292	192	119	58	6.3	4.0	9.9	25.9	98	203
Do	182423	254	282	180	112	54	6.3	3.1	9.6	23.8	93	198
Ulu Station	182308	259	290	195	115	58	6.2	5.0	11.0	25.0	98	202
Do	182309	280	306	195	122	56	6.8	4.9	11.1	25.4	97	210
Do	182311	262	285	195	114	57	6.9	5.0	9.2	24.2	96	204
Wami Hill	161914	258	291	192	114	58	7.8	4.2	9.7	24.2	98	196
Kitanga	182315	....	....	....	....	58	6.9	4.1	10.8	26.6	....	197
Park-reared.												
"McMillan lioness"	197137	265	291	209	120	59	11.0	10.0	15.4	26.9	95	200
Do	199524	265	300	224	119	64	14.6	16.0	19.0	28.1	102	206

[1] Died in Central Park Zoo, New York City. Roosevelt and Heller state (Life- Hist. African Game Animals, vol. 1, p. 225) that this is the record specimen in zygomatic width.

[2] Type specimen of *Felis leo roosevelti* Heller. From Emperor Menelik's Zoo. Presented by Menelik to President Roosevelt and died in Nat. Zoo. Park in Washington.

[3] Died in Nat. Zoo. Park, Washington. Early history unknown.

EXPLANATION OF PLATES.

PLATE 22.

(One-third natural size.)

Skull of wild-killed adult male *Felis leo massaica.* U.S.N.M., Cat. No. 155443; near Nairobi; British East Africa, 1908; collected by John Jay White.

PLATE 23.

(One-third natural size.)

Skull of park-reared adult male *Felis leo massaica.* U.S.N.M., Cat. No. 199707; captured as small cub near Nairobi, British East Africa; died in Nat. Zool. Park, Washington.

PLATE 24.

Skulls of adult female *Felis leo massaica* (one-third natural size).

Upper. Park-reared; U.S.N.M., Cat. No. 199524; captured as small cub near Nairobi, British East Africa; died in Nat. Zool. Park, Washington.

Lower. Wild-killed; U.S.N.M., Cat. No. 182326; Kapiti Station, British East Africa, 1911; collected by Paul J. Rainey.

PLATE 25.

Skulls of adult male *Felis leo massaica,* occipital views (reduced; same scale).

Upper. Wild-killed; U.S.N.M., Cat. No. 155443; near Nairobi, British East Afirca; collected by John Jay White.

Lower. Park-reared; U.S.N.M., Cat. No. 199707; captured as small cub near Nairobi, British East Africa; died in Nat. Zool. Park, Washington.

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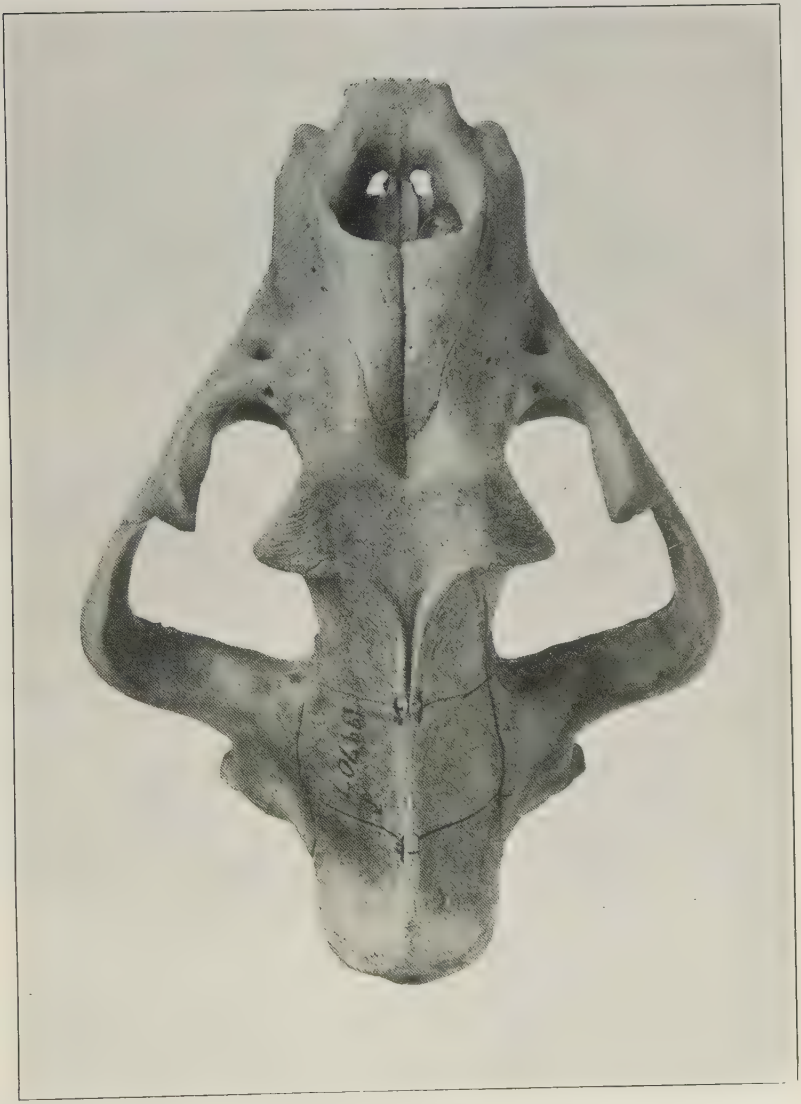
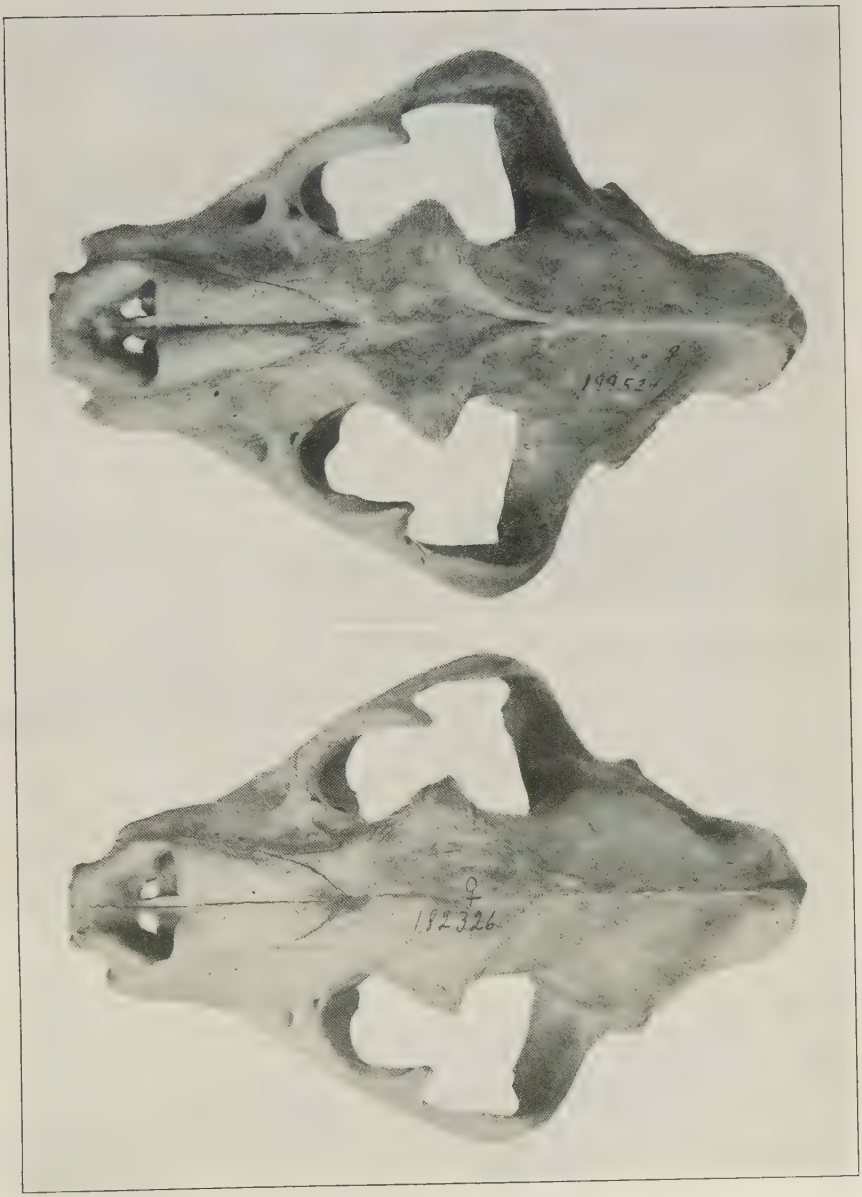
SKULL OF WILD-KILLED ADULT MALE FELIS LEO MASSAICA.

FOR EXPLANATION OF PLATE SEE PAGE 193.



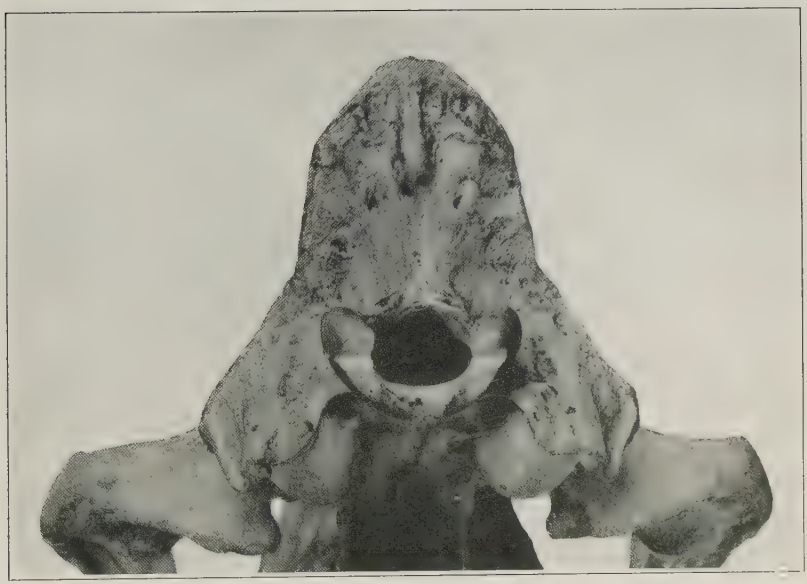
SKULL OF PARK-REARED ADULT MALE FELIS LEO MASSAICA.

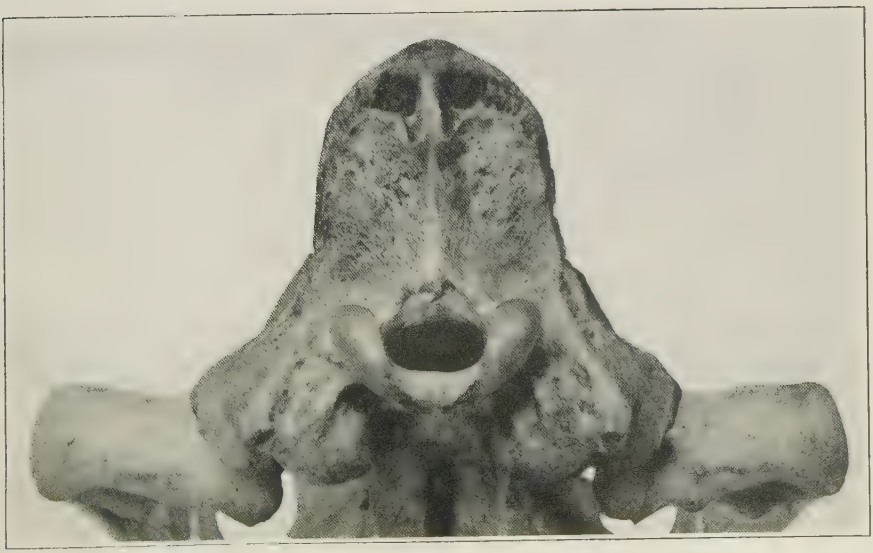
FOR EXPLANATION OF PLATE SEE PAGE 193.



SKULLS OF PARK-REARED (UPPER) AND WILD-KILLED (LOWER) LIONESSES.

FOR EXPLANATION OF PLATE SEE PAGE 193.





SKULLS OF WILD-KILLED (UPPER) AND PARK-REARED (LOWER) LIONS

FOR EXPLANATION OF PLATE SEE PAGE 193.

DESCRIPTIONS OF SOME NEW PARASITIC HYMENOPTERA.

By A. B. Gahan,

Of the Bureau of Entomology, United States Department of Agriculture.

This paper contains descriptions of 1 genus and 14 species of Ichneumonoidea, 1 genus and 11 species of Chalcidoidea, and 1 species of Proctotrypoidea believed to be new to science. Each species is described from reared material and is thus connected with a definite host record.

Superfamily ICHNEUMONOIDEA.

Family BRACONIDAE.

Subfamily Aphidiinae.

EPHEDRUS NITIDUS, new species.

Female.—Length 2 mm. Head impunctate, narrowed behind the eyes; antennae apparently ten-jointed, the apical joint, however, twice as long as the preceding and partially divided into two joints; mesoscutum polished, the parapsidal grooves nearly complete and terminating posteriorly in a dimple-like impression before the scutellar suture; pleura polished; propodeum distinctly areolated, shining, with the posterior face appearing more or less rugulose; wings hyaline, the second radial abscissa distinctly shorter than the first intercubitus; abdomen rather robust, a little longer than the head and thorax, polished except the first tergite which is rugulose and about one and one-half times as long as broad at apex. Head, thorax, and abdomen black; mandibles, palpi, and antennae, including scape, black or brownish black; coxae black, rest of the legs brownish testaceous to almost black in some specimens; stigma and nervures brownish testaceous.

This species differs from all others known to me in the short second radial abscissa, the more distinct parapsidal grooves, and the dimple-like impression on the mesoscutum.

Type-locality.—New Brunswick, New Jersey.

Type.—Cat. No. 20373, U.S.N.M.

Host.—Aphis brassicae.

Seven female specimens received from C. H. Richardson, and said to have been attacking *Aphis brassicae* in a greenhouse.

Subfamily VIPIINAE, new name for BRACONINAE of Authors.

Mr. H. L. Viereck has shown that the genera *Bracon* Fabricius and *Cremnops* Foerster are isogenotypic[1], and that the name *Bracon* must be used for the group of species formerly known as *Cremnops*. Unfortunately this change makes necessary the proposal of a new subfamily name for the Braconinae of authors, since the genus *Bracon* is no longer included in that group. The genus *Vipio* being the oldest genus remaining in the group, it is chosen as the type of the subfamily, which will consequently be known as Vipiinae.

MICROBRACON SANNINOIDEAE, new species.

Very similar to *mellitor* Say but differs as follows: The eyes are larger, more bulging and slightly wider in proportion to their length; the nervulus is usually exactly interstitial; the third abscissa of radius is longer than the combined first and second abscissae; the second abscissa of cubitus is usually distinctly shorter than the recurrent nervure; the second abdominal tergite is not emarginate medially, the suturiform articulation being straight instead of angularly broken at the middle.

Female.—Length 2.25 to 4 mm. Face finely shagreened; head above and the thorax smooth and polished; propodeum mostly smooth but with the apical half more or less rugulose; abdominal tergites finely wrinkled or shagreened; ovipositor exserted the length of the abdomen or a little more. Eyes and ovipositor sheaths black; flagellum dark brown or blackish; tips of mandibles and the tarsi brownish; wings slightly dusky, the costal vein and stigma dark brown, other veins paler; remainder of the body reddish testaceous, the mesonotum sometimes stained with blackish.

Male.—Similar to the female, but more often with the mesonotum and occasionally the mesosternum stained with blackish.

Type-locality.—College Park, Maryland.

Type.—Cat. No. 20374, U.S.N.M.

Host.—Sanninoidea exitiosa.

Described from many specimens reared by the writer from the cocoons of the peach-tree borer and recorded under Maryland Experiment Station Accession Cat. No. 809.

This species has been confused with *mellitor* in the literature, but can not be that species, since *mellitor* is a solitary parasite of *Anthonomus grandis* while *sanninoideae* is always gregarious, as many as 35 specimens often emerging from a single host cocoon.

[1] Bull. 83, U. S. Nat. Mus., 1914, pp. 23, 37.

Subfamily BRACONINAE.

The genus *Bracon* Fabricius, as shown in the remarks under the subfamily Vipiinae, must be transferred to the subfamily Agathidinae of authors. This being the case, the subfamily name Braconinae must be substituted for Agathidinae of authors, since otherwise we would have the family Braconidae with the genus *Bracon* as type, but no subfamily with *Bracon* as its type, which is contrary to the rules of nomenclature.

Subfamily MICROGASTERINAE.

MICROGASTER EPAGOGES, new species.

Female.—Length 3.5 mm. Closely allied to *M. carinata* Packard, but differs from that and related species in that the posterior tibiae and tarsi are black, with only a narrow basal annulus and a longitudinal stripe on the inner side of the tibiae pale. Face below antennae strongly rugoso-punctate, with a distinct carinate line medially extending from the antennal fossae about halfway to the base of clypeus; clypeus sculptured like the face, its anterior margin truncate; a line drawn between the eyes, tangent to the base of clypeus, would about equal a line from the antennal fossae to the base of clypeus; frontal depression with distinct curved rugae and divided medially by a smooth longitudinal carina; vertex with shallow, large, suberased punctures, more distinct along the posterior margin; posterior orbits similarly sculptured; cheeks sculptured about as strongly as the face; ocellocular line and postocellar line nearly equal; mesoscutum posteriorly with shallow, suberased punctures which become more distinct and closer on the anterior half, posterior half shining, the anterior half subopaque; scutellum practically smooth and polished, the transverse suture at base strongly crenulate; mesopleura smooth posteriorly, but with punctures similar to those of the mesoscutum anteriorly; propodeum coarsely rugose, with strong median and lateral longitudinal carinae; venation normal; abdomen about equal in length to the thorax, its first tergite broader at apex than long down the middle, narrowed at base and strongly rugose-punctate; second tergite sculptured like the first and nearly four times as broad as long; third tergite two-thirds the length of the second, its basal half punctate, but more weakly so than the second tergite, its apical half and all of the following tergites smooth; ovipositor sheaths rather broad and subequal in length to the middle femora. Head, thorax, all coxae, basal joint of hind trochanters, large blotch on hind femora above, hind tibiae except a narrow basal annulus and an incomplete longitudinal stripe on the inner side, hind tarsi, and the abdomen black; antennae including the scape black; palpi pale yellowish; fore and median legs

and the hind femora except as noted reddish yellow; sides of the abdominal venter obscurely yellowish basally; wings subhyaline with blackish tinge, the veins and stigma brownish black.

Male.—Agrees with the female.

Cocoons.—Pure white.

Type-locality.—Nashville, Tennnessee.

Type.—Cat. No. 20375, U.S.N.M.

Host.—Epagoge sulfureana.

Thirteen specimens reared by C. C. Hill from the larvae of the above-mentioned host and recorded in the Bureau of Entomology under Webster No. 8337.

APANTELES DIACRISIAE, new species.

Female.—Length 2.5 mm. Head closely punctate except the depression above the antennae and before the ocelli which is smooth; antennae about equal to the body in length, the first four flagellar joints subequal and nearly four times as long as thick, the following joints gradually shorter; mesoscutum closely punctate and subopaque, scutellum polished with some suberased punctures; mesopleura anteriorly punctured like the mesoscutum, posteriorly polished; propodeum rugose with a weak median carina; hind coxae impunctate or nearly so; abdomen about equal to the head and thorax in length, strongly laterally compressed beyond the base of the fourth segment, the hypopygium rather large and prominent; the first tergite with its sides straight and parallel, about one and one-half times as long as broad, its apex distinctly narrower than the base of the second tergite; first and second tergites strongly sculptured, the third down the middle and at base more weakly so; ovipositor slightly exserted. Head and thorax black; palpi and tegulae pale testaceous; legs reddish testaceous, except base of hind coxae, which are blackish, and the hind tarsi, which are brownish; antennae dark brown, wings hyaline, the veins testaceous at base of wing, the outer veins and stigma pale brownish; abdomen blackish above, the sides and venter concolorous with the legs. In some specimens the whole abdomen except the two or three basal tergites is more or less testaceous.

Male.—Agrees with the female except that the abdomen is shorter, scarcely at all compressed apically and the hind coxae have more black at base.

Type-locality.—Washington, District of Columbia.

Type.—Cat. No. 20401, U.S.N.M.

Host.—Diacrisia virginica.

Described from eleven specimens reared in September, 1915, from larvae of the above-named host by Dr. F. H. Chittenden and recorded under Chittenden No. 4908.

This species is very close to *parorgyiae* Ashmead, but differs in the parallel-sided first tergite, the more strongly compressed apex of the abdomen and the smooth hind coxae.

Subfamily CHELONINAE.

CHELONUS PHTHORIMAEAE,[1] new species.

Female.—Length 3 mm. Antennae 16-jointed; head, thorax, and abdomen finely rugose-punctate, opaque; the scutellum shining, sparsely punctate medially, its margins and apex with larger elongate punctures; median posterior portion of the mesoscutum more coarsely sculptured than elsewhere on the mesoscutum; propodeum rugose with a subquadrate median dorsal area, the posterior face bounded dorsally with a carina the lateral angles of which are produced into rather strong teeth and between these are two smaller teeth, one at each lateral posterior angle of the median dorsal area; first abscissa of radius a little longer than the second; radial cell short; femora, and tibiae swollen, the posterior tarsi slender and longer than their tibiae; abdomen shorter than the head and thorax. Black; the femora and tibiae varying from black to reddish testaceous; wings hyaline.

Male.—Similar to the female except for a large transverse fissure at the apex of the abdomen.

This species very closely resembles *shoshoneanorum* Viereck, but differs by having the clypeus distinctly punctate though more or less shining; the rugosities of the face less evidently transverse; the inner orbits below the antennae with practically no striations parallel to the eye margin; the parapsidal grooves less sharply defined owing to the coarser sculpture of mesoscutum, the rugosities of the abdomen assuming less the form of parallel lines, the abdomen viewed from the side is more truncate at apex and the ventral concavity of the abdomen extends nearly to its apex.

Type-locality.—Rocky Ford, Colorado.

Type.—Cat. No. 20376, U.S.N.M.

Host.—Phthorimaea operculella.

Three specimens from the type-locality reared by H. O. Marsh from the potato tuber moth and recorded in the Bureau of Entomology under Chittenden No. 955. Paratypes also from Los Angeles and Ventura, California, reared by J. E. Graf, from the same host under Chittenden Nos. 2236 and 2126, respectively. Two specimens from San Diego, California, from the same host, without further data.

[1] This species is figured under the name *Chelonus shoshoneanorum*. Bull. 427, U. S. Dept. Agric., p. 40, figs. 29–30.

PHANEROTOMA FRANKLINI, new species.

Female.—Length 4.25 mm. Differs from other North American species by having the first abscissa of radius less than half the length of the second abscissa. Head finely rugulose, except the clypeus, which is smooth with sparse fine punctures; the clypeus is large, and on the anterior margin are three minute teeth; malar space shorter than the width of a mandible at base; mandibles bidentate, the upper tooth much longer than the lower; eyes large, about equal in width to the posterior orbits, which are broad and only slightly narrowed behind; ocelli in a very slightly acute-angled triangle, antennae 23-jointed, the first flagellar joint nearly four times as long as thick, following joints gradually shorter, the apical eight or ten joints subquadrate and submoniliform; thorax gradually rugulose and opaque, except the propleura, which are more or less shining, with slightly coarser sculpture; propodeum rugose, the posterior lateral angles slightly prominent; forewings faintly fuscous, with the base and a streak below the stigma hyaline; radius originating much beyond the middle of stigma, its second abscissa about two-thirds the length of first intercubitus and nearly twice as long as second intercubitus; abdomen about equal to the thorax in length, strongly sculptured, bicarinate at base, the two carinae converging and nearly or quite meeting at apex of the first tergite; ovipositor slightly exserted. General color reddish testaceous; eyes and spot enclosed by ocelli black; apex of antennae fuscous; hind tibiae dark reddish brown or blackish on apical half with a whitish band just before the middle, the base reddish; forewings faintly fuscous with the base and a streak below the stigma hyaline, veins and stigma brown, the base and apex of latter yellowish.

Male.—Differs from the female only in the usual sexual characters.

Type-locality.—East Wareham, Massachusetts.

Type.—Cat. No. 20377, U.S.N.M.

Host.—*Mineola vaccinii.*

Described from a number of specimens reared from larvae of the cranberry fruit worm by Dr. H. J. Franklin, for whom the species is named. The species has been referred to in literature by Doctor Franklin under the name of *Phanerotoma tibialis*[1] Haldeman, but is readily distinguished from what we are calling that species by the different character of radius.

[1] Bulletin No. 150, Mass. Agric. Exp. Sta., 1914, p. 55; also Bull. No. 160, Mass. Agric. Exp. Sta., 1915, p. 109; 28th Annual Report, Cape Cod Cranberry Growers Association, 1915, p. 28.

Subfamily OPIINAE.

OPIUS PEGOMYIAE, new species.

Female.—Length 3.8 mm. Runs to *kukakense* in the writer's published key to the genus,[1] but differs from that species by the second abscissa of radius being distinctly less than twice as long as the first abscissa and slightly more than half as long as the first transverse cubitus; by the first abdominal tergite being as broad at apex as long down the middle, by having the area on the mesoscutum surrounding the median fusiform impression more or less distinctly wrinkled and by the more robust form of the body.

Head above shining, the vertex more or less indefinitely rugulose along the occipital margin; face rugulose-punctate with a rather strong median ridge which is nearly smooth, the frontal depression smooth medially; clypeus fitting close to the mandibles, strongly punctate except apically and about thrice as broad as long down the middle; eyes short oval and about as broad as the posterior orbits; antennae 37-jointed in the type; mesoscutum mostly smooth, but with the anterior margin punctate and a rugulose area surrounding the deep fusiform impression posteriorly; scutellum elevated and strongly rugose; parapsidal grooves absent except at the anterior lateral angles; sides of the prothorax and an area beneath the wings on the mesopleura rugose; propodeum rugose; first abdominal tergite rugose, the following tergites polished; ovipositor concealed. Head, thorax, and abdomen black; mandibles except at apex, palpi, and all legs excepting the posterior coxae rufo-testaceous; flagellum black; wing veins and stigma mostly dark brown, paler toward the base of wing.

Male.—Similar in all respects to the female, except that the ventral margin of the mandible has a more or less distinct notch or tooth near the base.

Type-locality.—Oxnard, California.

Type.—Cat. No. 20378, U.S.N.M.

Host.—Pegomyia vicina.

Six specimens from the type-locality reared from pupae by B. L. Boyden and recorded in the Bureau of Entomology under Chittenden No. 3106.

OPIUS CORIACEUS, new species.

Female.—Length 2 mm. In the writer's recently published revision of the Opiinae of North America,[1] this species runs in the key to species of *Opius* to category 47, but may be distinguished from any species included there by the distinct, fine, close, coriaceus sculpture of the entire head, thorax, and abdominal tergites.

[1] Proc. U. S. Nat. Mus., vol. 49, 1915, p. 68.

Antennae slender, longer than the body, 29-jointed in the type; head, viewed from above, about twice as broad as long, the posterior orbits about equal to the transverse diameter of the eye and only slightly receding; eyes oval; broad opening between clypeus and mandibles; the ventral margin of mandibles without a notch; malar space a little less than the width of a mandible at base; parapsidal grooves effaced behind the middle of the mesoscutum which is without a median impression posteriorly; scutellum flat, sculptured like the mesoscutum, the transverse suture between it and the mesoscutum crenulate; mesopleura with a longitudinal impression below the middle which is not crenulate; propodeum finely rugulose and opaque all over, without carinae; stigma of forewing lanceolate, emitting the radius much before the middle; recurrent nervure interstitial; second abscissa of radius nearly twice the first transverse cubitus; the radial cell terminates slightly before the extreme wing-apex; first abdominal tergite sculptured like the propodeum, bicarinate at base, the carinae uniting about the middle of the tergite and extending as a median carina nearly to the apex; second and following tergites with sculpture similar to that of the mesoscutum but finer; abdomen ovate, about equal in length to the thorax, the ovipositor exserted about the length of the sixth tergite. Black: scape and pedicel beneath, clypeus, mandibles except at apex, tegulae, all legs, including coxae, the coalesced second and third tergites and to some extent the fourth tergite testaceous; posterior tibiae slightly tinged with fuscous; wings hyaline, the veins and stigma brown.

Male.—Similar to the female in every way except that the antennae are 28-jointed in the type, and the third and fourth abdominal tergites have a brownish apical band, while the tergites beyond the fourth are not black but dark brownish.

Type-locality.—Greenwood, Mississippi.

Type.—Cat. No. 20379, U.S.N.M.

Host.—*Ceradontha dorsalis.* Reared from pupal stage of host.

A male and female reared by H. E. Smith and recorded in the Bureau of Entomology under Webster No. 12814, Cage. No. B-90.

OPIUS OTIOSUS, new species.

Female.—Length 2.5 mm. In the writer's key to the species of *Opius*[1] this runs straight to *unifasciatus* Ashmead and is extremely like the type of that species, but differs in having the first tergite more distinctly sculptured and only the extreme apical segments of the abdomen blackish, instead of most of the abdomen being black as in *unifasciatus*.

Head strongly transverse, smooth and polished; face broad, with a slight but distinct impression each side of the middle extending

[1] Proc. U. S. Nat. Mus., vol. 49, 1915, p. 68.

from the base of the clypeus about halfway to the antennae and setting off a broad, low, rounded median ridge on the lower part of the face, the depressed areas very faintly sculptured; clypeus with sparse distinct punctures, narrow, strongly arched anteriorly and forming with the mandibles a broad, elliptical opening; posterior orbits rounded and equal to about half the width of the eye; occiput with a distinct carina laterally which is effaced behind the vertex; antennae inserted above the middle of the eye, 31-jointed in the type, the first flagellar joint about three times as long as thick, the second slightly shorter; mesoscutum and scutellum shining with very faint coriaceus sculpture, the notauli absent except for a short deep fovea at the lateral anterior angles of the mesoscutum; mesopleura smooth except that the impression below the middle is broad and strongly rugoso-punctate; entire propodeum coarsely rugose; radial cell extending nearly to the extreme apex of wing; first radial abscissa scarcely longer than thick, second abscissa about one and one-half times the length of the first intercubitus, second cubital cell narrowed outwardly, recurrent nervure interstitial; abdomen about equal to the thorax in length, broadly ovate, the first tergite nearly one and one-half times as long as broad, its sides nearly parallel, depressed at base, the apical middle broadly elevated and granularly rugulose; tergites beyond the first smooth and polished; ovipositor concealed from above. Scape, pedicel, two or three basal joints of the flagellum, mandibles except at apex, palpi, tegulae, legs including all coxae, and the abdomen except at apex bright reddish testaceous; apex of abdomen more or less blackish; face piceus; remainder of the body black; wings hyaline, the stigma and veins brownish.

Male.—Differs in no respect from the female.

Type-locality.—Brownsville, Texas.

Type.—Cat. No. 20380, U.S.N.M.

Host.—Agromyza parvicornis.

Eighteen specimens reared by C. L. Scott from puparia of the above-mentioned Agromyzid and recorded in the Bureau of Entomology under Webster No. 6486.

NEOPIUS, new genus.

Occiput completely margined; body with distinct coriaceus sculpture. Other characters as in *Opius*. In the writer's revision of the North American Opiinae[1] would run to the genus *Ademon* on the margined occiput but may be distinguished from that genus by the completely closed radial cell and the absence of any prepectal carina. In *Ademon* the radius is effaced before attaining the wing margin and the prepectal area is set off by a sharp carina.

Type of the genus.—Neopius carinaticeps, new species.

[1] Proc. U. S. Nat. Mus., vol. 49, 1915, p. 66.

NEOPIUS CARINATICEPS, new species.

Male.—Length 2 mm. Head transverse, twice as broad as long as viewed from above; vertex and frons coriaceously wrinkled, the vertex posteriorly with a row of large punctures along the occipital carina; face strongly granularly sculptured with a polished elevated median line or ridge; clypeus nearly smooth, elevated anteriorly and forming with the mandibles a transverse elliptical opening; eyes elliptical; malar space about equal to the base of a mandible; posterior orbits nearly as broad as the eye width, polished as are also the cheeks; antennae 26-jointed in the type, the first flagellar joint subequal in length to the combined scape and pedicel, the second and following joints shorter and decreasing in length toward the apex of antennae; mesoscutum shining with faint coriaceous sculpture, more distinct posteriorly, the parapsidal grooves deep and crenulate anteriorly becoming shallow behind the middle and terminating in a deep median fovea in front of the scutellum; transverse groove at base of scutellum crenulate; scutellum shining, very faintly coriaceous; mesopleura strongly coriaceous, with a curved depressed area below the tegulae and the episternauli deeply foveolate; propodeum coarsely rugose, without carinae; second radial abscissa longer than the first intercubitus by about the length of the second intercubitus, second cubital cell narrowed apically, recurrent nervure interstitial, radial cell terminating considerably before the extreme wing apex; stigma lanceolate, emitting the radius at about its basal one-third; abdomen ovate, about as long as the thorax; first tergite bicarinate, rather narrow and completely rugulose; following tergites polished. Head reddish testaceous, with the face medially, the frons entirely, the vertex except a broad orbital line, and the occiput above black; thorax and abdomen except the second tergite black; second tergite for the most part and all of the legs including their coxae reddish testaceous; wings hyaline, venation pale brownish.

Female.—Agrees with description of male, except that the antennae in female allotype are 30-jointed; the malar space is somewhat shorter than the basal width of a mandible, and the first tergite is broader at apex than at base, one and one-half times as long as broad at apex and striato-rugose with the lateral carinae less apparent; tergites beyond the first piceus; ovipositor concealed from above.

Type-locality.—Wimbledon, North Dakota.

Type.—Cat. No. 20381, U.S.N.M.

Three male specimens from the type-locality, reared, according to the labels, from "Agromyza mine in Hordeum," by C. N. Ainslie and recorded in the Bureau of Entomology under Webster No. 13761. Allotype female and a paratype male from New Jersey.

Subfamily ROGADINAE.

ROGAS[1] PERPLEXUS, new species.

Female.—Length 3.8 mm. Head and thorax with fine, close, granular sculpture. Head transverse, narrowed behind, the posterior orbits hardly half as wide as the transverse diameter of the eyes; ocelli small, the greatest diameter of a lateral ocellus slightly less than the postocellar line which is about equal to the ocell-ocular line; eyes distinctly but not deeply emarginate, malar space longer than the width of a mandible at base; opening between clypeus and mandibles not large; antennae 33-jointed in the type, all flagellar joints two or more times as long as thick; parapsidal grooves present but not deeply impressed; mesopleura sculptured like the mesoscutum and scutellum; propodeum granularly rugulose with a median longitudinal carina; first radial abscissa of the forewing shorter than the first transverse cubitus and a little more than half the length of the second radial abscissa; second cubital cell narrowed slightly apically; submedian cell longer than the median by about one and one-half times the length of the nervulus; abdomen as long as the head and thorax, the first, second, and third tergites very finely rugulose, the first and second with a median carina which is also traceable on the third; ovipositor exserted about the length of the fourth tergite. Color dark fusco-testaceous, the eyes, triangle enclosed by ocelli, mesoscutum except broad parapsidal stripes, upper part of mesopleura, mesosternum, propodeum, base of first tergite, and the ovipositor sheaths blackish; antennal flagellum blackish apically, the basal half brownish testaceous; legs including all coxae brownish testaceous; wings hyaline, venation dark brown, the stigma pale at base and apex.

Male.—Agrees with the description of female.

Type-locality.—Tempe, Arizona.

Type.—Cat. No. 20382, U.S.N.M.

Host.—Peridroma margaritosa.

Type, allotype, and four paratypes from Tempe, Arizona, reared by L. J. Hogg, from the larvae of *Peridroma margaritosa* and recorded under Webster No. 11978; paratype reared by W. R. McConnell at Roswell, New Mexico, from unknown larvae and recorded in the Bureau of Entomology under Webster No. 12634; paratype, Brownsville, Texas, R. A. Vickery, Webster No. 6437, reared from *Heliothis obsoleta;* paratype, Springer, New Mexico, C. N. Ainslie collector, Webster No. 5535, host unknown.

This species is closely related to *autographae* Viereck, from which it differs principally by having larger ocelli, more finely sculptured

[1] If the conclusions of Mr. Viereck in Bull. 83, U. S. Nat. Mus., p. 7, are correct this name should be changed to *Aleiodes.*

second and third abdominal tergites, a smoother fourth tergite, and generally more obscure testaceous markings.

ROGAS POLITICEPS, new species.

Female.—Length 8 mm. Vertex, frons, and posterior orbits polished; impunctate; face transversely wrinkled; opening between clypeus and mandibles large; malar space about equal to the width of a mandible at base, possibly a little longer; ocellocular line not quite twice the greatest diameter of an ocellus; eyes long oval, distinctly emarginate; posterior orbits as broad as the transverse diameter of the eyes and only slightly receding; antennae 62-jointed in the type, the first flagellar joint about one and one-half times as long as broad, the following joints subquadrate; mesoscutum smooth; the parapsidal grooves distinctly impressed, foveolate, and terminating posteriorly in a striate area; scutellum smooth; mesopleura mostly smooth, with a slightly rugulose area just beneath the anterior wing; propodeum entirely rugose with a rather weak median carina; radius of the forewing with its second abscissa not quite twice as long as the first, but only slightly longer than the first intercubitus, the second cubital cell subquadrate; nervulus nearly twice its own length beyond the basal nervure; hind femora about two-thirds the length of their tibiae, tarsal claws pectinate; abdomen about as long as the head and thorax; first, second, and third tergites with strong parallel striae, those of the second and third tergite continuous across the suturiform articulation and terminating a little before the apex of the third tergite; first and second tergites with a distinct median carina which does not extend on the third tergite; apex of third tergite and all of the following tergites smooth; ovipositor about equal to the fifth tergite in length, not extending beyond the apex of abdomen. Eyes, ocelli, antennae, and ovipositor sheaths black, posterior tibiae shading from testaceous at base to black or blackish at apex, their tarsi black, median and anterior tibiae and tarsi similar to the posterior but not quite so dark; body otherwise dark reddish testaceous; wings blackish, becoming somewhat paler toward the apex.

Male.—Differs in no way from the female.

Type-locality.—Nashville, Tennessee.

Type.—Cat. No. 20383, U.S.N.M.

Host.—*Peridroma incivis.*

Type female reared by G. C. Ainslie at Nashville, Tennessee, from the larvae of the above-named host, and recorded in the Bureau of Entomology under Webster No. 12397–B. Allotype collected by E. S. Tucker at Natchez, Mississippi, together with a female paratype. Paratype female, Dallas, Texas, collected by R. A. Cushman at light; paratype female, Tallulah, Alabama, R. A. Cushman col-

lector; paratype female, Victoria, Texas, J. D. Mitchell collector; paratype male, Thomasville, Alabama, W. D. Pierce collector.

ROGAS RUFOCOXALIS, new species.

Female.—Length 5.6 mm. Head transverse, the posterior orbits about as broad as two-thirds the eye-width; sparsely punctate and polished; vertex transversely rugose; ocelli rather large, in an equilateral triangle, the postocellar line less than the ocellocular; frons less strongly wrinkled than the vertex; face transversely rugulose above with a strong median ridge; cheeks punctured and shining like the posterior orbits; malar space distinctly longer than the width of a mandible at base; opening between clypeus and mandibles moderately large and nearly circular; eyes distinctly though not deeply emarginate; antennae longer than the body, 47-jointed in the type, the first flagellar joint about twice as long as broad or a little longer, following joints slightly shorter; mesoscutum and scutellum shining with weak punctures, the parapsidal grooves terminating posteriorly in a rugulose area; propodeum rugose with a distinct median carina; tarsal claws distinctly pectinate; first abscissa of radius shorter than the second which is about equal to the first intercubitus, second intercubitus equal to the first or nearly, the second cubital cell subquadrate; nervulus far behind the basal vein, the first and second abscissae of discoideus equal or nearly so; abdomen a little longer than the thorax, the first, second, and basal half of the third tergites strongly rugosostriate with a distinct median carina on the first and second; apex of third and all of the following tergites polished. Head, antennae including scape, palpi, and all legs except their coxae black; thorax, abdomen, and all coxae rufo-testaceous; wings hyaline, the costal vein and stigma black, other venation dark brown.

Male.—Similar in every respect to the female except that the apical segments of the abdomen are blackish and closely covered with white hairs.

Type-locality.—Rocky Ford, Colorado.

Type.—Cat. No. 20385, U.S.N.M.

Hosts—Autographa brassicae and *Peridroma margaritosa.*

Type, allotype, and four paratypes reared by H. O. Marsh from larvae of *Autographa brassicae* and recorded in the Bureau of Entomology under Chittenden No. 1088; also two males and one female from Tempe, Arizona, reared by L. J. Hogg, from larvae of *Peridroma margaritosa* and recorded under Webster No. 11978.

This species is apparently exactly like the type of *molestus* Cresson except that the mesosternum, mesopleura, and propodeum of *molestus* are black. It would not be surprising if it would ultimately turn out to be merely a color variety of Cresson's species.

Family ICHNEUMONIDAE

Subfamily OPHIONINAE.

NEPIERA BENEVOLA[1] Gahan, variety FUSCIFEMORA, new variety.

Female.—Length 6 mm. Apparently differs from the type of *N. benevola* only by the hind femora outwardly having a broad blackish or fuscous stripe from base to apex.

Male.—Like the female except that the outer side of the hind femora are entirely black or blackish.

Type-locality.—Pasadena, California.

Type.—Cat. No. 20384, U.S.N.M.

Host.—Phthorimaea operculella.

Two females and one male reared by J. E. Graf and recorded in the Bureau of Entomology under Chittenden No. 2230[e3].

Superfamily CHALCIDOIDEA.

Family CALLIMOMIDAE

Subfamily MONODONTOMERINAE.

LIODONTOMERUS SECUNDUS, new species.

Female.—Length 1.7 mm. Very similar to *L. perplexus*, but differs as follows: The antennal funicle is slightly longer, its joints, except the first which is slightly transverse, subquadrate or at least not distinctly broader than long; the anterior wing beneath the marginal vein has a large more or less distinct fuscous spot occupying the median portion of the wing; the ovipositor is distinctly longer than the abdomen or about two-thirds the length of the body; otherwise agrees with the description of *perplexus*.

Male.—Similar to the male of *perplexus*, but distinguished by the fuscous spot on the wing.

Type-locality.—Caldwell, Idaho.

Type.—Cat. No. 20386, U.S.N.M.

Host.—Bruchophagus funebris. External parasite of larvae.

Eight females and one male reared by T. D. Urbahns, October 10, 1914, and recorded under Webster No. 13300, Bureau of Entomology.

LIODONTOMERUS INSUETUS, new species.

Female.—Length 1.5 mm. Differs from *L. perplexus* by having the ovipositor fully as long as the abdomen, the scutellum projecting apically so as to form a slight ledge above the short metanotum, the propodeum sloping nearly perpendicularly from its base, all tibiae

[1] This species is figured under the name *Nepiera benevola* in Bull. 427, U. S. Dept. Agric., p. 47, fig. 44.

pale throughout, and the head and thorax less strongly sculptured. Readily distinguished from *secundus* by the absence of any stigmal cloud in the forewing, the projecting scutellum, and the more nearly perpendicular propodeum.

Head and thorax closely punctate, somewhat shining, the punctures rather shallow and indefinite on the lateral lobes of the mesoscutum, the scutellum and axilae; antennae with all joints of the funicle and club transverse though not strongly so; pedicel longer than thick; propodeum faintly sculptured; postmarginal vein of the forewing about twice the length of the stigmal; abdomen finely lineolated. Head and thorax green, abdomen bronzy, the tergites tinged with green basally; all coxae and femora concolorous with the thorax, the tibiae and tarsi pale testaceous; wings hyaline, the veins pale; antennal flagellum and pedicel brownish, the scape testaceous. Male unknown.

Type-locality.—Tempe, Arizona.

Type.—Cat. No. 20387, U.S.N.M.

Six females reared by R. N. Wilson and recorded in the Bureau of Entomology under Webster No. 7270E. The types were reared from seed infested with *Bruchophagus funebris* and it is probably parasitic on that host.

Family PTEROMALIDAE

Subfamily PTEROMALINAE.

SYSTELLOGASTER, new genus.

Runs to Coelophisthia in Kourdumoff's key to the Pteromalidae, but may be separated from that genus by the fact that the face is not abruptly truncate below the antennae, but only slightly receding, the antennae being inserted considerably above the clypeus though distinctly below the middle of the face; the wings are distinctly though not strongly ciliated on the disk and the first antennal ring joint is transverse. Differs from *Dibrachys* and *Coelopisthoidea* principally in the abdomen being short and subtruncate at apex instead of conic ovate, and the propodeum incised at the posterior lateral angles for the reception of the hind coxae, giving the appearance of a short broad neck; the propodeal spiracles large.

Type of the genus.—Systellogaster ovivora, new species.

SYSTELLOGASTER OVIVORA, new species.

Female.—Length 1.8 mm. Antennal pedicel more than twice as long as the first funicle joint, first ring joint transverse, the second nearly as long as wide, funicle six-jointed, the joints subequal and about as long as wide, or slightly transverse, club not broader than

the funicle, and but slightly longer than the two preceding funicle joints. Head transverse, vertex broad, ocelli in a low triangle, the occiput concave and angularly defined with a faint carinate margin; posterior orbits receding; face convex, frons and vertex distinctly reticulated, the face below antennae much more closely finely sculptured; eyes bare; antennae inserted somewhat below the middle of the face; pronotum short, narrower than the mesonotum, and punctate; mesoscutum and scutellum closely and deeply punctate, opaque, the sculpture of the scutellum slightly finer than that of the mesoscutum; axillae somewhat shining, with shallow reticulations; mesopleura closely punctate; propodeum punctate with a distinct median carina, the lateral folds rather shallow toward the apex; anterior wings without marginal cilia, the discal cilia short but distinct; posterior wing with distinct short marginal cilia; marginal vein of the front wing nearly three times as long as the postmarginal, the stigmal and postmarginal subequal; abdomen shorter than the thorax, nearly as broad as long and subtruncate apically, the tergites smooth, the first tergite equal to about one-third the length of the abdomen, following tergites gradually shortening. Head and thorax dark bluish, with more or less distinct brassy reflections on the lower part of the face and the mesoscutum; scutellum almost black, but with coppery reflections in some lights; abdomen black; wings hyaline at base and apex but with a broad transverse fuscous band or cloud between the base of the marginal vein and the apex of the stigmal or a little beyond; venation dark brown; legs, including coxae, all brownish testaceous; antennal scape pale, the pedicel and flagellum dark brown.

Male.—Agrees with the female in every respect, except that it is smaller and slightly more highly colored.

Type-locality.—Urbana, Illinois.

Type.—Cat. No. 20388, U.S.N.M.

Host.—Blatta orientalis.

Described from eight specimens reared by J. R. Malloch from egg cases of the above-mentioned Blattid August 14, 1914. The writer obtained the same species from egg cases of a Blattid at College Park, Maryland, June 10, 1914.

PTEROMALUS HEMILEUCAE, new species.

Female.—Length 3.8 mm. Head and thorax with close deep punctation; head broader than the thorax, viewed from in front broader than high, the cheeks convexly rounded, clypeal region strongly striated, anterior margin of the clypeus with a shallow median emargination; mandibles each with four strong teeth; ocelli in a low triangle, the postocellar line distinctly longer than the ocellocular line; first funicle joint slightly longer than the pedicel, the second a little shorter than the first, following funicle joints successively

shorter, the last a little longer than thick; club three-jointed and only slightly longer than the two preceding funicle joints. Mesoscutum punctured like the head, but with the punctures on the posterior middle deeper and coarser than elsewhere; apical one-fourth of the scutellum with deeper and slightly coarser punctures than anteriorly, the line of demarkation between the two kinds of punctation quite distinct and often more or less of a transverse furrow, the extreme apical margin of scutellum with a median emargination, visible only when viewed from directly behind; propodeum between the lateral folds punctured like the thorax, without a median carina, outside the lateral folds shining and only faintly sculptured, the spiracular sulci deep and foveolate; stigmal vein only slightly shorter than the marginal vein, the postmarginal much longer than the marginal; abdomen conic ovate, about equal to the thorax in length, the tergites practically smooth, but with some obscure reticulate lines. Head and thorax dark greenish, the abdomen bronzy black with greenish reflections; scape and pedicel pale reddish; flagellum nearly black; mandibles piceus; all coxae concolorous with the thorax; all femora dark brown; basal half of median and hind tibiae brownish; the front tibiae, apical half of median and hind tibiae and all tarsi except the apical joint pale yellowish; wings hyaline, the venation pale brownish with the stigmal knob and the thickened apical portion of the submarginal vein nearly black.

Male.—Unknown.

Type-locality.—Maxwell, New Mexico.

Type.—Cat. No. 20389, U.S.N.M.

Host.—Hemileuca oliviae.

Thirteen females reared from the pupa of the above-named host by C. K. Wildermuth and recorded in the Bureau of Entomology under Webster No. 5054.

EUPTEROMALUS TACHINAE, new species.

Female.—Length 2.3 mm. Head closely reticulate-punctate, the sculpture becoming shallower below the antennae, the mouth region striate; head strongly transverse, broader than the thorax, as viewed from above nearly four times as broad as long; occiput concave, ocelli in a low triangle; viewed from in front the head is broader than long, the antennae inserted a little below the middle of face; antennal scape reaching to the front ocellus, pedicel longer than the first joint of funicle; two ring-joints, the first small, the second as long as broad; first funicle joint a little longer than broad, the following joints successively a little shorter; club three-jointed, conic-ovate, and a trifle longer than the two preceding funicle joints; mesoscutum sculptured like the head, the scutellum similarly but

more finely sculptured; propodeum with a distinct neck and deep lateral folds, but without a median carina, the area between the folds strongly sculptured like the mesoscutum, laterad of the folds polished except posteriorly and rather thickly covered with whitish pile; anterior wings with the marginal and postmarginal veins subequal, the stigmal slightly shorter than the post-marginal; abdomen not longer than the thorax, subpetiolate, smooth and polished, the first tergite occupying two-thirds to three-fourths of its length, second and following tergites short and narrowing rapidly to the apex: ovipositor concealed. Head, thorax, and coxae aeneous, scape and legs except coxae reddish testaceous, pedicel brownish, flagellum black, wings hyaline, the venation brownish, abdomen purplish black except basally where it is more or less brassy.

Type-locality.—Nashville, Tennessee.

Type.—Cat. No. 20390, U.S.N.M.

Four females reared at Nashville, Tennessee, by W. H. Larrimer, from the puparium of a Tachinid parasite of *Leucania unipuncta*, probably *Archytes analis*, and recorded under Webster No. 11332, Bureau of Entomology. Five specimens also from Guelph, Canada, reared by A. W. Baker from *Leucania unipuncta*.

EUTELUS BRUCHOPHAGI, new species.

Female.—Length 1.75 mm. Head with fine, close, shallow thimble-like punctures; viewed from above the head is more than twice as broad as long; occiput concave; posterior orbits narrow and rounded: ocelli in an obtuse triangle, the postocellar line longer than the ocellocular; eyes short ovate, nearly circular; malar space long, equal to about two-thirds the length of the eye; antennae inserted on a line with the lower extremity of the eyes; scape cylindrical and not reaching to the anterior ocellus, pedicel longer than the first funicle joints: three ring-joints distinct; funicle five-jointed the joints subequal and subquadrate; club three-jointed, ovate, considerably broader than the funicle, the whole club about equal in length to the three preceding funicle joints. Mesoscutum, scutellum and mesopleura sculptured like the head; propodeum obscurely wrinkled, more or less shining, with distinct lateral folds and a rather weak median carina; marginal and postmarginal veins subequal, the latter a little the shorter; stigmal vein distinctly shorter than the postmarginal; abdomen about as long as the head and thorax, conic ovate, smooth and polished, the first tergite a little shorter than the three following combined. Head and thorax blackish green, abdomen blackish with the first tergite brassy green; coxae concolorous with the thorax: all femora dark brownish or blackish, paler at apex; median and hind tibiae reddish brown, their apices together with the front

tibiae and all tarsi paler; scape reddish testaceous, flagellum dark brown; wings hyaline, veins pale brownish.

Male.—Length 1.35 mm. Sculpture of the head and thorax similar to that of the female but stronger; abdomen oval, not longer than the thorax; head and thorax brassy green; scape and all funicle joints testaceous, pedicel brownish above, club black; legs, except coxae, concolorous with the antennal scape; forewing with the area between the postmarginal and stigmal veins cloudy, rest of the wing hyaline. Other characters as in female.

Type-locality.—Nephi, Utah.

Type.—Cat. No. 20391, U.S.N.M.

Host.—Bruchophagus funebris Howard.

Four females and eleven males reared by T. D. Urbahns, October 26, 1914, and recorded under Webster No. 13315. Also a large series of male paratypes reared from *B. funebris* material at Salt Lake, Utah, by T. R. Chamberlin and recorded under Webster No. 6612.

Family EULOPHIDAE.

Subfamily ENTEDONINAE.

CHRYSOCHARUS MALLOCHI, new species.

Very similar to *Chrysocharus parksi* Crawford but differs in having the petiole much shorter than the hind coxae, the propodeum short and without a distinct hump toward the apex, and the coxae all pale like the rest of the legs.

Female.—Length 1.54 mm. Green with strong brassy reflections on the head and thorax above; the lower part of face, scutellum, pleura, and abdomen beyond the first tergite purplish or bronzy; face below distinctly wrinkled, frons almost smooth or with very faint reticulations; first funicle joint nearly twice as long as the pedicel and slightly longer than joint two; club with two joints and an apical spine; mesoscutum and scutellum faintly reticulated; propodeum nearly smooth with apparently two faint medial carinae, mesopleura with an oval sunken area which, like the prepectus, is distinctly sculptured; wings hyaline, the postmarginal vein more than twice as long as the stigmal; abdomen short, ovate, smooth dorsally, the petiole rugulose and abruptly narrowed basally.

Male.—Essentially like the female.

Type-locality.—Parker, Illinois.

Type.—Cat. No. 20392, U.S.N.M.

Host.—Agromyza felti Malloch.

Four specimens sent to the Bureau of Entomology under Illinois State Laboratory of Natural History No. 45806, and labeled as reared April, 1914, by J. R. Malloch.

DEROSTENUS PALLIPES, new species.

Female.—Length 1.4 mm. Differs from all described species by having the legs, except their coxae, entirely white. Head, thorax, and abdomen brilliant metallic green, the face below the middle bright golden, with strong close sculpture, vertex nearly smooth, the occiput sculptured much like the face, eyes distinctly hairy; scape pale, flagellum black; mesonotum and scutellum strongly punctate, the propodeum and dorsum of the abdomen smooth; wings hyaline, with a stigmal cloud. In sculpture closest to *D. fullowayi* Crawford, but readily separated by the color of the legs and the smooth abdomen.

Type-locality.—College Park, Maryland.

Type.—Cat. No. 20393, U.S.N.M.

Host.—*Phytomyza aquilegiae.*

One specimen reared by Mr. E. N. Cory, of the Maryland Experiment Station, from the above-named leaf miner in Columbine (*Aquilegia*).

Subfamily TETRASTICHINAE.

TETRASTICHUS AINSLIEI, new species.

Female.—Length 1.35 mm. Face nearly smooth, with very faint reticulations and a few small round obscure punctures on the vertex and frons and along the inner eye margins; funicle joints subequal, the first longer than the pedicel; club not thickened and about as long as the second and third funicle joints combined, apparently two-jointed, the second joint twice as long as the first and terminating in a short spine; thorax with fine shallow lineolation, median groove of the mesocutum present but not very distinct; mesopleura faintly reticulate; propodeum uniformly faintly sculptured with an indication of a median carina; submarginal vein of the fore wing with a single stiff bristle on the dorsal side; abdomen above, with obscure reticulate sculpture. Head, thorax, and apical two-thirds of the abdomen black; basal third or a little more of the abdomen, antennal scape, and legs for the most part yellow; flagellum blackish, the pedicel brownish; mandibles rufous; front coxae and basal half of the median and hind pairs black; femora often more or less stained with fuscous; wings hyaline, the venation pale.

Male.—Essentially like the female, except for the usual sexual characters.

Type-locality.—Elkpoint, South Dakota.

Type.—Cat. No. 20394, U.S.N.M.

Eight specimens recorded in the Bureau of Entomology under Webster No. 11815, and reared according to C. N. Ainslie from *Mordellistena*, species. This species may be distinguished from all other species having a single bristle on the submarginal vein by the pale band at the base of the abdomen. Named for the collector, C. N. Ainslie.

TETRASTICHUS DOLOSUS, new species.

Female.—Length 1.3 mm. Falls in the group having more than one bristle on the submarginal vein. Frons, vertex, and occiput finely sculptured; antennae rather short, the pedicel about equal to the first funicle joint, three funicle joints subequal and subquadrate; club about as long as the funicle but broader, three-jointed, the two basal joints slightly transverse, the apical joint shorter and conical; apparently a single ring-joint. Mesoscutum and scutellum finely and closely lineolate; parapsidal grooves deep, praescutum divided by a complete but faint median groove; scutellum convex with two distinct longitudinal grooves; metanotum smooth; propodeum practically smooth with a median longitudinal carina; marginal vein slightly thickened. Abdomen conic-ovate, about equal to the thorax in length, the tergites finely sculptured except the base of first which is smooth. Antennae black; head, thorax, abdomen, all coxae and all femora metallic blue-green; all femora narrowly at apex, all tibiae and all tarsi pale, the apical tarsal joint brownish. Wings hyaline, venation brownish.

Male.—The single specimen lacks the head. In the available characters it is like the female, except slightly smaller, with the abdomen narrower and nearly elliptical, and the propodeum more distinctly sculptured.

Type-locality.—Tallulah, Louisiana.

Type.—Cat. No. 20395, U.S.N.M.

Hosts.—*Euplectrus platyhypenae* and *Euplectrus comstocki.*

Two female specimens reared by R. A. Vickery at Tallulah, Louisiana, from *Euplectrus platyhypenae* parasitizing *Laphygma frugiperda* and recorded under Webster No. 6439. Also five specimens including the allotype from Wellington, Kansas, reared by T. S. Wilson under Webster No. 12450 and labeled as reared from *Euplectrus comstocki* parasitizing *Caradrina*, species.

The type of this species bears the same locality label and Webster number as do the types of *Tetrastichus euplectri* Gahan, previously described and appears to have been from the same rearing. The two species are quite distinct from each other, however, and may be easily separated by the fact that *euplectri* has much longer antennal joints, only one bristle on the submarginal vein, and the femora all pale.

Subfamily EULOPHINAE.

NOTANISOMORPHA MEROMYZAE, new species.

Female.—Length 2.4 mm. Antennae inserted on the middle of the face, moderately long; scape reaching slightly above the anterior ocellus, pedicel about one and one-half times as long as its apical width, first funicle joint about twice as long as the pedicel and distinctly longer than the second, the second very slightly longer than the third, fourth joint the shortest and only slightly longer than broad; club short, about equal to the first funicle joint in length, two-jointed, joint one about equal in length to the fourth funicle joint, joint two about as long as broad and tapering to a point at apex. Head and thorax closely punctate, the punctures of the pronotum and middle of the mesoscutum coarser than those of the scutellum, axillae and lateral lobes of the mesoscutum; metanotum punctate like the mesoscutellum; propodeum finely closely punctate all over, the punctures a little finer and deeper than those of the scutellum, with a distinct median longitudinal carina and rather broad spiracular sulci; abdomen ovate, a little shorter than the thorax, the first tergite polished, tergites beyond the first faintly sculptured. Head, thorax, all coxae, and the first tergite metallic green, antennae including scape black; wings hyaline, the venation brownish; legs except coxae testaceous, the median and posterior femora and their tibiae basally slightly infuscated with brownish; abdomen except the first tergite blackish.

Male.—Length 2 mm. Joints 1, 2, and 3 of the funicle each bearing a long slender branch, the branches each extending to or nearly to the apex of antennae, first funicle joint the shortest of the funicle joints, joints 2 and 3 about equal, joint 4 the longest and about twice as long as the first; club subequal to the fourth funicle joint in length, two-jointed as in the female. Except in antennal characters the male is similar to the female but a little more slender bodied, and slightly more metallic in color.

Type-locality.—La Fayette, Indiana.

Type.—Cat. No. 20396, U.S.N.M.

Host.—Meromyza americana.

Two females from the type locality reared, according to the labels, from the above-named host by P. Luginbill and recorded in the Bureau of Entomology under Webster No. 9734. Mr. Luginbill is unable to state the stage of the host from which the parasite emerged. The allotype reared by C. N. Ainslie at Elkpoint, South Dakota, is recorded under Webster No. 8840, and is said to have been reared "without much question from the pupae of *Meromyza americana*. There is also a chance that it may have come from a mine of *Agromyza coquilletti* in wheat blades, but this is not likely, as most of the leaves had been stripped from the stem."

Superfamily PROCTOTRYPOIDEA.

Family PLATYGASTERIDAE.

POLYMECUS LASIOPTERAE, new species.

Female.—Length 1.1 mm. Head polished, impunctate; antennal scape somewhat swollen, pedicel nearly twice as long as thick, about equal in length to the two first funicle joints combined; first funicle joint smaller than the second; the second, third, and fourth funicle joints subequal; club not strongly differentiated from the funicle, 4-jointed, the joints, except the last, subequal and very slightly longer than broad, the apical joint conic-ovate and about one and one-half times as long as thick; mesoscutum and mesopleura polished impunctate, the parapsidal grooves absent; mesoscutellum polished, convex, without an apical spine; metapleura longitudinally aciculate-striate; propodeum short, apparently with a carina each side of the median line; abdomen strongly compressed dorso-ventrally, nearly twice as long as the head and thorax, broadest at apex of the second segment, beyond gradually and evenly tapering to a point at apex; first tergite longitudinally striate, the tergites beyond the first perfectly smooth and polished; second tergite the longest, about twice the length of the third; tergites beyond the second subequal in length. Whole insect black except base of scape, the trochanters, all tibiae at base, and all tarsi which are more or less testaceous; wings hyaline.

Male.—Agrees with the female, except that the second funicle joint is more swollen, being much broader and twice as long as the third joint, the first funicle joint is very small, and the abdomen is barely longer than the head and thorax combined, spatulate in outline as seen from above, the apex rounded.

Type-locality.—Elk Point, South Dakota.

Type.—Cat. 20397, U.S.N.M.

Six females and one male reared by C. N. Ainslie from *Lasioptera*, species infesting *Muhlenbergia* and recorded in the Bureau of Entomology under Webster No. 11838.

DESCRIPTION OF A NEW SPECIES OF MASTODON, GOMPHOTHERIUM ELEGANS, FROM THE PLEISTOCENE OF KANSAS.

By Oliver P. Hay,

Research Associate of the Carnegie Institution of Washington.

The specimen here described was found about 1908 near McPherson, Kansas, by Mr. Frank Dillon, of the town named. It was met with in a sand pit, at a depth of about 35 feet, in section 34, township 19 north, range 3 west. The tooth was presented to the United States National Museum by Mr. Dillon.

Type-specimen.—A lower left hindermost molar, No. 8255, of the United States National Museum.

Type-locality.—McPherson, McPherson County, Kansas.

Type-formation.—Sheridan beds.

Diagnosis.—The lower hinder molar furnished with six cross-crests, or five cross-crests and a large talon, a deep longitudinal median cleft and principal cones and accessory conules. Outer ends of valleys closed by buttresses and forming trefoils on wear. Inner ends of valleys partially closed by accessory conules.

Judging from the narrowness of the tooth and the fact that the crests run across the crown somewhat obliquely, the writer concludes that it is the lower left hindermost molar. It had not yet been cut and is therefore wholly unworn. The pulp cavity is large and the roots had not yet been developed. Unfortunately, in the process of exhumation, the tooth was injured somewhat; but nevertheless it is in good condition.

The length of the tooth is 217 mm.; its width at the first cross-crest, 83 mm.; at the fourth, 85 mm. It will be seen from the measurements and the figures (pl. 26, figs. 1, 2) that the tooth is a long and relatively narrow one. There are present six cross-crests, the hindermost one being something more than a talon. The inner and the outer halves of each crest are separated by a narrow but very deep cleft. Each half of each crest may be regarded as composed of two cones, the principal one and another nearer the mesial cleft. The latter does not rise quite as high as the principal cone and is separated from the latter by a cleft.

To these four cones of each crest may be added accessory conules. It is probable that at a later time the median cleft and those sepa-

rating the parts of each lateral half of the crests would have been hidden by a deposit of cement; but a specimen of a tooth of *G. floridanum* in a similar stage of development has already a rather thick layer of this.

The outer cones of each crest are furnished with buttresses which effectually close up the transverse valleys. These buttresses are mostly composed of subsidiary conules, which cling closely either to the parts of the principal cone or to one another. The row of conules forming the anterior buttress of the first crest runs into the anterior cingulum. The posterior buttress is composed of two conules, the hinder of which is applied to a conule which forms the anterior buttress of the second crest. The hinder buttress of this second crest, apparently of three or four flattened conules, joins the anterior buttress of the third crest; but it appears to be carried also inward and downward by a row of flattened conules between the inner halves of the second and third crests. The posterior buttress of the third crest is similarly disposed, as is also that of the fourth crest. The hinder buttress of the fifth crest is less completely developed.

On wear the outer halves of the three anterior crests would produce each a trefoil; the succeeding two would form less complete ones.

There is a tendency for the formation of buttresses on the cones of the inner half of the tooth. In the first transverse valley the inner buttresses are nearly as complete as the outer ones. In the second transverse valley there is an accessory conule attached to the front of the third crest, but none to the rear of the second crest; nor are there buttresses on the succeeding crests. At the inner end of the first transverse valley there is a very large tubercle. There was a similar one at the inner end of the fourth valley.

The injuries done to the tooth make it difficult to speak with confidence regarding the cingulum, but this appears to have been present along the outer face of the tooth. At the outer end of each valley there is a cluster of small tubercles, and these appear to have met across the base of the outer cones.

The tooth here described resembles somewhat the corresponding one of *Gomphotherium tropicum* (Cope), of the Blanco Pliocene; but in the McPherson tooth there are a greater subdivision of the principal cones and a larger number of accessory conules in the valleys. It is also not greatly unlike the corresponding tooth of *Gomphotherium floridanum*, likewise a Pliocene species. The latter, however, very rarely develops buttresses on both halves of the crests; and it appears to have had properly only four cross crests and a talon. Likewise, the principal cones of *G. floridanum* appear to be more obtuse than those of *G. elegans*.

The region about McPherson is covered by deposits which belong to the Sheridan, or Equus, beds. We have in this tooth, therefore, evidence that the bunolophodont mastodons continued on into the Pleistocene. This is confirmed by the discovery of an upper second molar probably of this species and of a maxilla with two teeth of another species in the Pleistocene of Texas. The latter will be described and figured elsewhere.

The upper second molar mentioned above belongs to the right side. The tooth is in the collection of Baylor University, at Waco, Texas. It was found in Pleistocene deposits on Hog Creek, McLennan County, near Speegleville, a town about 8 miles west of Waco. The crown is practically complete, but the roots are missing. The length is 145 mm., the width 90 mm. There are three crests and a large talon. The wear on the two anterior crests has produced on the inner half of each a large trefoil. Where the enamel of these trefoils joins the outer cones it is considerably folded. There are very distinct buttresses on the outer halves of the crests, especially of the first and second. The anterior buttress of the second crest is double.

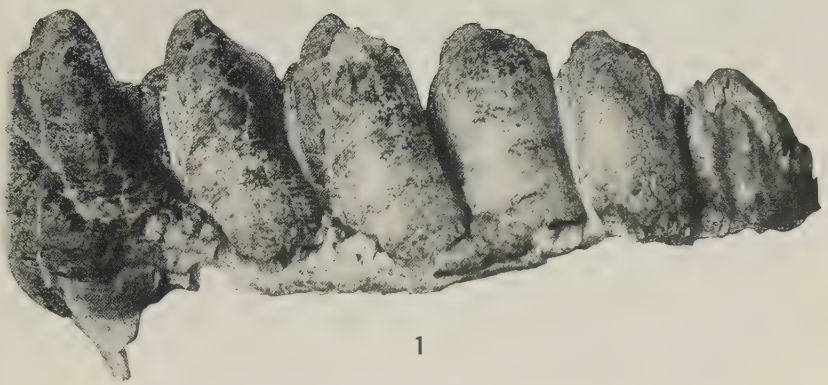
This tooth is larger than the corresponding one of any other mastodon known to the writer; but its size corresponds to that of the type tooth. Its complication is greater than in the hinder molar, but that might be expected. This tooth resembles somewhat those which Cope[1] has referred to *G. humboldii;* but the crests are not so closely appressed and the enamel is not so strongly folded. The tooth described by Cope belonged to the Blanco Pliocene.

EXPLANATION OF PLATE 26.

Gomphotherim elegans. $X \frac{1}{2}$.

Figs. 1, 2. Lower third molar found at McPherson, Kansas.
Fig. 3. Upper second molar found near Waco, Texas.

[1] 4th Ann. Rep. Geol. Surv. Texas, p. 60, pls. 16, 17.



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GOMPHOTHERIUM ELEGANS.

FOR EXPLANATION OF PLATE SEE PAGE 221.

GOMPHUS PARVIDENS, A NEW SPECIES OF DRAGONFLY FROM MARYLAND.

By Bertha P. Currie,

Of the Bureau of Entomology, United States Department of Agriculture, Washington.

The new species described herein was collected in a field along the Anacostia River just west of the Laurel and Berwyn trolley line. Here the river, in some places only a few yards wide, meanders for some distance through weedy fields. The banks, in some places low and level and in others from one to several feet high and abrupt, are bordered here and there with trees of a low growth. The stream is broken in places by rapids or riffles and here and there, during low water, are bars of sand or gravel. It was a cloudy afternoon in late May, and the only dragonflies secured were a few specimens of *Ischnura posita* and the single *Gomphus* on which this description is based.

My thanks are due to Mr. E. B. Williamson, of Bluffton, Indiana, for reading the manuscript of this paper and contributing valuable suggestions.

GOMPHUS PARVIDENS, new species.

Male.—Length of abdomen, including appendages, 28.5 mm.; length of hind wing, 24 mm. Colors dark brown or black, and yellow. Head yellow, black or brown as follows: Rear of head on upper half, hind margin of occiput, vertex, antennæ, frons basally, a fine line on fronto-nasal suture, minute spots at base of labrum, and tips of mandibles. Postocellary vertical ridge somewhat sinuous, not attaining the eyes. Occiput about same height as level of eyes, slightly convex, without median prominence or spine.

Prothorax dark brown, yellow as follows: Front lobe, except line on hind margin widening to a patch at each end; on median lobe, a lateral patch and a geminate median spot; anterior to this a pale triangular depression with apex to the rear (this may darken with age); on hind lobe, a median spot.

Mesothorax dorsally brown to beyond the humeral suture, marked with yellow as follows: Mesothoracic semicollar except for a slight interruption at middorsal carina; a line along middorsal carina from crest to collar; a pair of dorsal stripes one-third to one-half of a millimeter in width, divergent anteriorly and uniting with ends of semicollar; a narrow, slightly sinuous antehumeral stripe, interrupted above,[1] the part above interruption a wider spot; and the posterior part of antealar sinus. Lobes between wings yellow. Mesothorax and metathorax laterally yellow, except an interrupted narrow stripe on first lateral suture, a narrow stripe on second lateral suture, and other markings as in diagram (pl. 27, fig. 2); ventrally yellow. Legs dark brown, front femora inferiorly and coxae yellow; hind femora extending to about the center of abdominal segment 2, armed with numerous short spines, the hairs inconspicuous. Wings (pl. 27, fig. 1) hyaline; veins black, pterostigma brown, membranule gray; two cells between A_1 and A_2 at their origin, the proximal and anterior of these the first postanal cell, the other the distal part of the divided second postanal cell; the first postanal cell not divided; neither A_1 nor A_2 distinctly angled, two rows of cells between them to the wing margin.[2]

Abdomen black or dark brown, yellow as follows: On segments 1 and 2, a middorsal stripe, narrowed apically on 2, and a lateral stripe including the auricles on 2; on base of 3, a small dorsal spot, pointed behind, and a larger lateral one; on base of 4 to 7, a similar dorsal and a small lateral spot; on 8 and 9, a broad lateral patch; 10 ventrally. Segments 7 to 9 moderately expanded, narrower than the thorax; segment 8 slightly longer on dorsal than on ventral side;[3] 8 longer than 9; hind margin of 10 somewhat produced middorsally.

Superior appendages (pl. 28, figs. 1, 2, and 3) dark brown or black, a little longer than segment 10, acute apically, bearing a small, sym-

[1] This interruption is narrow and perhaps may not always occur.

[2] The characters in the postanal cells in the genus *Gomphus* have been studied by Mr. Williamson and the results published by him. (See Williamson, E. B. "The subgenus *Stylurus* Needham: Selys' groups VI and VII of the genus *Gomphus* (Odonata), and on the postanal cells of the latter." In Trans. Amer. Ent. Soc., vol. 27, pp. 205–217, pls. 8, 9. May, 1901. *Gomphus parvidens* falls under *1, 1'*, and *1''* in Mr. Williamson's table, page 215.

The following corrections should be made in his paper:

Page 205, lines 13 and 16, for *second* read *first*.

Page 214, under the heading, "North American species," in line beginning "6. *G. soridius*," for *sp. a.* read *s. pa.*

In key, page 215, in referring to branches of anal vein, throughout for *first* read *second*, and for *second* read *first*.

Page 216, in explanation of Plate 8, *f.—f.* is second branch and *s.—s.* is first branch of anal vein; and *i. e.* is part of first branch of anal vein.

Page 217, under explanation of Plate 9, line 3, for *penus* read *penis*.

[3] Mr. Williamson has shown that the shape of the apex of segment 8 of the abdomen is difficult of accurate definition as a distinctive character. (See Williamson, E. B., "*Gomphus pallidus* and two new related species (Odonata)." In Ent. News, vol. 25, pp. 49–58, pls. 4, 5. February, 1914. See pp. 50 and 58 and pl. 4, fig. 8.)

metrical, nearly vertical inferior tooth at about three-fourths distance from base to apex; in ventral aspect of the appendage (pl. 28, fig. 2) this tooth is located at the posterior end of an ovate concavity. Inferior appendage (pl. 28, figs. 1, 2, and 3) laterally and apically black, hairy, about the same length or a little shorter than the superiors, not extending so far laterad, its hind margin moderately excavate.

Accessory genitalia of second segment (pl. 28, fig. 7): Anterior hamules pale yellow at base, dark apically and behind; posterior hamules nearly vertical (directed a little posteriorly), large, pale yellow, ending in a hook, brown at tip, which is directed forward and, viewed ventrally, inward; vesicle large, erect, dark brown, laterally shiny.

Type-locality.—Lakeland, Prince Georges County, Maryland.

Type.—Cat. No. 20367, U.S.N.M.

Described from one specimen collected by the author May 22, 1915, while it was resting in a field along the Anacostia River.

Before the drawings and photograph were made and the description drawn up, the specimen of *Gomphus parvidens* met with an accident, in which the left superior appendage was lost and the wings were slightly damaged. When collected the specimen was not fully chitinized, and in consequence segment 10 is somewhat distorted ventrally; but it was bristled, pinned, and spread the day after collection and there was little if any fading or discoloration of the bright markings in drying.

Gomphus parvidens (pl. 28, figs. 1, 2, 3 and 7; pl. 27, figs. 1 and 2) may be distinguished from *G. brevis* Hagen (pl. 28, figs. 6 and 10; pl. 27, fig. 3), *G. abbreviatus* Hagen (pl. 28, figs. 4 and 8), and *G. viridifrons* Hine (pl. 28, figs. 5 and 9), to which it seems most nearly related, by the narrower pale stripes of the thoracic dorsum (compare pl. 27, figs. 2 and 3), the more symmetrical shape of the male superior appendages, viewed laterally, and the shape of the accessory genitalia of the second segment.

The following key will help in distinguishing the males of these four species:

Key for the separation of the males of Gomphus parvidens, G. brevis, G. viridifrons, and G. abbreviatus.

1. Dorsal thoracic pale stripe (pl. 27, fig. 3) anteriorly from one-half as wide to wider than adjoining middorsal dark area; apical half of superior appendage viewed from side bilaterally unsymmetrical 2

   Dorsal thoracic pale stripe (pl. 27, fig. 2) anteriorly about one-fourth as wide as adjoining middorsal dark area; apical half of superior appendage viewed from side almost bilaterally symmetrical ..... *parvidens.*

2. Face heavily lined with black; superior appendages about same length as inferior appendage ..... *brevis.*
Face not lined with black; superior appendages plainly longer than inferior appendage 3
3. Rear of head black, except for one or more small spots near margin of eye; inferior appendage in lateral aspect strongly narrowing in apical half; genital vesicle in lateral aspect long, slender, its apical half directed slightly backward ..... *viridifrons.*
Rear of head pale on lower half, black on upper half; inferior appendage in lateral aspect not strongly narrowing in apical half; genital vesicle in lateral aspect short, stout, erect ..... *abbreviatus.*

The following material has been studied: The single male of the new species *Gomphus parvidens*, described herein; 34 males and 34 females of *G. brevis* and 7 males and 4 females of *G. abbreviatus*, collected at Orono, Maine, during June and July of 1898 and 1899 by F. L. Harvey and Bartle Harvey (Coll. U.S.N.M.); and a male of *G. viridifrons*, collected at Ohio Pyle, Pennsylvania, June 25, 1900, by E. B. Williamson (Coll. E. B. Williamson).

The specimens from which the drawings were made are so labeled and, with the exception of *Gomphus viridifrons*, are in the collection of the United States National Museum.

EXPLANATION OF PLATES.

PLATE 27.

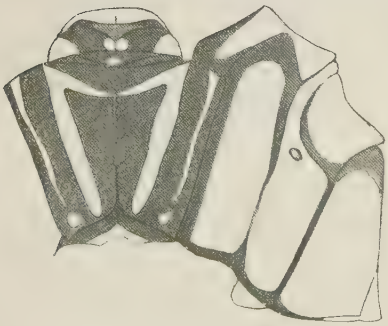
Figure 1 is from a photograph by Mr. H. J. Paine, of the Bureau of Entomology. The outlines in figures 2 and 3 are adapted by the writer from one used by Mr. E. B. Williamson in illustrating markings in the genus *Cyanogomphus*.

FIG. 1.—*Gomphus parvidens.* Male, dorsal view, X 2.
2.—*Gomphus parvidens.* Diagram showing pattern of thoracic markings.
3.—*Gomphus brevis.* Diagram showing pattern of thoracic markings.

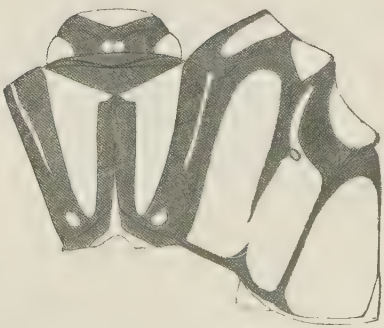
PLATE 28.

FIGS. 1–3 and 7. *Gomphus parvidens.* 1. Terminal abdominal appendages of male, dorsal aspect. 2. Same, ventral aspect. 3. Same, lateral aspect. 7. Accessory male genitalia of second abdominal segment, lateral aspect.
4 and 8. *Gomphus abbreviatus.* 4. Terminal abdominal appendages of male, lateral aspect. 8. Accessory male genitalia of second abdominal segment, lateral aspect.
5 and 9. *Gomphus viridifrons.* 5. Terminal abdominal appendages of male, lateral aspect. 9. Accessory male genitalia of second abdominal segment, lateral aspect.
6 and 10. *Gomphus brevis.* 6. Terminal abdominal appendages of male, lateral aspect. 10. Accessory male genitalia of second abdominal segment, lateral aspect.
Drawings for all figures executed by Miss Esther Hart, of the Bureau of Entomology.

1



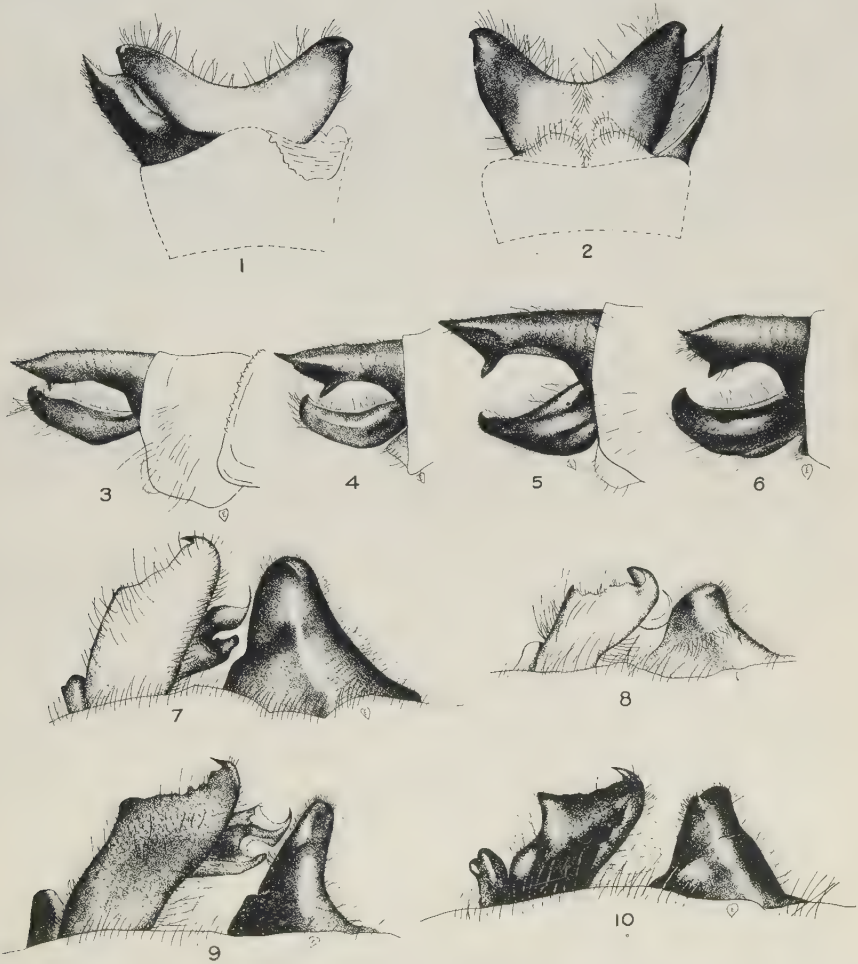
2



3

GOMPHUS PARVIDENS AND GOMPHUS BREVIS.

FOR EXPLANATION OF PLATE SEE PAGE 226.



GOMPHUS PARVIDENS, G. ABBREVIATUS, G. VIRIDIFRONS, AND G. BREVIS.

FOR EXPLANATION OF PLATE SEE PAGE 226.

A REMARKABLE OCCURRENCE OF CALCITE IN SILICIFIED WOOD.

By Edgar T. Wherry,

Assistant Curator, Division of Mineralogy and Petrology.

The material here described was collected by Mrs. Charles D. Walcott in Yellowstone National Park during the summer of 1915. It is dark brown in color and shows, even to the naked eye, unmistakable vegetable fiber. Dotted through the mass are minute white grains, with rhombic crystal outlines, and with dark central nuclei. The wood has been examined by Dr. F. H. Knowlton and identified as *Sequoia magnifica* Knowlton.[1] The major part of the replacing material is silica, but the crystal grains are calcite, and the features shown by the latter mineral are so unusual that a special study of it has been made.

When thin sections are examined under the microscope the positions of the calcite grains are found to bear no definite relation to the wood structure; they cut across the cells in all directions. They are bounded by somewhat convex crystal planes; by measuring the angle between the trace of the vertical axis (located by the interference figure in convergent polarized light), and these planes, in a number of grains lying on their sides, the dominant form was determined to be *e*, the half negative rhombohedron: observed 24–26°, calculated 26° 15′. The base, *c*, is sometimes obscurely developed, as is also the unit rhombohedron *r*. A few of the grains are single crystals, but the majority of them are formed by the intergrowth of several crystals. The individuals appear always to be intergrown in twinning position, the twinning plane being *r*, the unit rhombohedron, the vertical axes accordingly making angles of 90° 46′ with one another, and extinction in the two parts of the twin being at times nearly simultaneous. This twinning is often polysynthetic, several thin lamellae making up the central part of the grain, while the outermost portions develop normally. Complicated multiple twins also occur.

[1] Knowlton, F. H., Fossil flora of the Yellowstone National Park, U. S. Geol. Surv. Mon. 32, pt. 2, 1899, p. 761, pls. 104, 105, 110, 111, and 117, figs. 1–6.

The most interesting features of these calcites are their inclusions and exclusions of wood fiber. The relations of these can be best appreciated by reference to the illustrations accompanying this article. Their main features may be summed up here. Toward the center of each grain a portion of the wood fiber is preserved as an inclusion. The cells have not been greatly distorted, but the outlines of the groups of cells are determined by the crystallographic character of the grains. As a result of the elongation of inclusions in polysynthetic twinning lamellae curious symmetrical figures have been produced, some of them resembling insects. The cells are completely enveloped in calcite substance, and no silica has been observed in any of the included portions of wood.

Surrounding the central group of wood cells there is usually a zone of entirely clear calcite, although in some instances the cells extend outward and are continuous with those outside the crystal. Toward the outer edge of the clear zone there is usually a band of very minute, disrupted fragments of cells; and these often descend along the boundaries of twinning lamellae into the mass of undisturbed cells at the center.

The margins of the crystals are generally sharply outlined against the darker wood, and the crystal faces are always distinctly curved. The phenomena exhibited outside the crystals are also noteworthy. In all cases where any considerable proportion of a calcite crystal is clear a dense black rim surrounds it. This is evidently composed of wood cell material crowded out of the growing crystal. The wood structure just beyond this rim is sometimes curved around the crystals, although usually no effect whatever can be observed. These relations show that the wood must have been decomposed to such an extent that it soaked up the solutions as does a sponge, and had lost practically all rigidity, so that compression exerted by growing crystals produced no effect beyond the cells in the immediate neighborhood of the crystals.

Outside of the calcite crystals the wood cells are, in general, very well preserved as dark-brown carbonaceous matter. Between crossed nicols all openings are seen to be completely filled with quartz, an individual crystal occupying each cell. The deposition of this has evidently taken place from solutions which permeated the whole cell structure; and since crystallization occurred about as rapidly on one side of a cell wall as on the other, the structure was not distorted thereby.

A certain amount of distortion is shown by the wood cells, but it is of such a type as to indicate that it was produced by the pressure of overlying sediment on the rotted wood, rather than by the growing of crystals. If anything the cells included in the calcite grains are

less affected than those without, indicating that the growth of the calcite took place fairly early in the history of the specimen.

That the calcite was the first mineral to form is shown by the facts that its grains possess crystal outline and inclose only woody matter, never silica. When calcite crystallizes from solutions contained in the pore spaces between grains of sand it frequently incloses the latter, yielding "sand calcites," of which many occurrences have been described. In the present instance the wood, in the process of decay, evidently became saturated with a solution capable of depositing calcite, and wood cells were inclosed, much as are the sand grains in the "sand calcites."

The only reasonable hypothesis which suggests itself to account for the outer portions of the crystals excluding wood cells instead of including them is that of decrease in rate of crystallization. It is well known in the study of crystallization that the rapid formation of crystals renders them particularly likely to inclose mother liquor, gas bubbles, or foreign particles suspended in the solution; slow formation, on the other hand, furnishes opportunity for the growing crystals to push aside such obstacles. According to this view the solutions percolating into the decomposing wood were at first well saturated with calcium carbonate, and when crystallization was inaugurated—perhaps by warming, by changes in pressure, or by removal of carbon dioxide through the agency of bacteria—it went ahead at first at a relatively rapid rate. The wood cells were at this time included in the crystals.

As the solutions became depleted in calcium carbonate, however, the rate of crystallization naturally slowed down and exclusion of the cells took place. In time growth ceased, and a rim of cell material surrounded the crystals. Then a slight renewal of calcium carbonate in the solution occurred, and a thin layer of crystal matter deposited over the surface of the previously formed crystals; this also excluded most of the cell matter in its path, but traces remained behind to mark the level of temporary cessation of growth. Silica solutions then flowed in, and all remaining cavities were filled by quartz.

EXPLANATION OF PLATES.

On the plates are shown photomicrographs of thin sections of the wood containing calcite crystals.

PLATE 29.

(Enlarged 10 times.)

Shows simple and twinned crystals, different forms of inclusions, the lack of influence of the wood structure on the directions of crystal growth, and the lack of distortion of the wood cells by the crystals.

PLATE 30.

(Enlarged 20 times.)

FIG. 1. Shows at top a simple crystal with central inclusion, outer clear zone, and thin line of dark matter near margin, the heaping up of a dark rim at sides, and the slight parting of the cells at either end. Near the bottom a twinned crystal, with the inclusion continuous with the outer cells at one end and partitioned among the twinning lamellae at the other; the lack of distortion of the cells is evident.

FIG. 2. Shows near center large irregularly twinned crystals, with the included cells partially continuous with those outside, but greater distortion toward the margin than in the center of the crystal.

PLATE 31.

(Enlarged 20 times.)

FIG. 1 (part of Plate 29, further enlarged). Shows compound twin crystals with marked partition of inclusions among the several parts of the twins, yielding insectlike forms. The dark rims of excluded cell material are also well developed.

FIG. 2. Shows symmetrical partition of inclusion in a "fish tail" twin crystal.

FIG. 3. Shows at top a crystal seen end on, the central inclusion being slightly eccentric. Below, a multiple twin with unusually faint inclusions.

SILICIFIED WOOD CONTAINING CALCITE.

FOR EXPLANATION OF PLATE SEE PAGE 229.

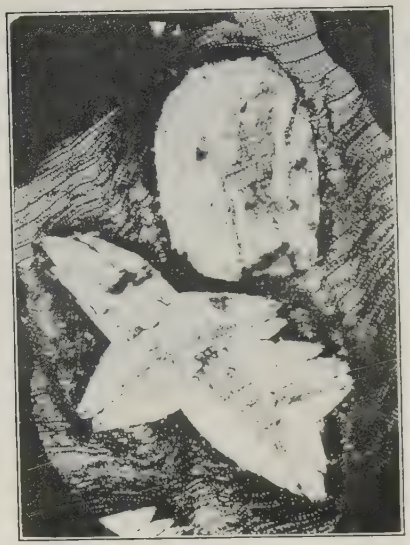
1

2

SILICIFIED WOOD CONTAINING CALCITE.

FOR EXPLANATION OF PLATE SEE PAGE 230.

1



2

3

SILICIFIED WOOD CONTAINING CALCITE.

FOR EXPLANATION OF PLATE SEE PAGE 230.

AN ASYMMETRICAL BIRD-LOUSE FOUND ON THREE DIFFERENT SPECIES OF TROUPIALS.

By John Howard Paine,

Of the Bureau of Entomology, United States Department of Agriculture.

In a paper on the possible relation of the Mallophaga to bird phylogeny, Harrison (1914) mentions and figures the heads of three asymmetrical species of bird-lice, *Lipeurus quadrimaculatus* Piaget. *L. asymmetricus* Piaget, and *Degeeriella asymmetrica* Nitzsch, considering them congeneric, inasmuch as all three are from related hosts, all Struthiones.

The writer, however, has recently come into possession of several specimens of both sexes of an asymmetrical form taken from skins of three closely related Icterids, collected by the Smithsonian Biological Survey of the Panama Canal Zone in 1911 and 1912—viz, Wagler's Oropendola, *Zarynchus wagleri* (Cana, E. Panama, Feb. 12, 1912), and two Caciques, *Cacicus microrhynchus* (Rio Indio, Canal Zone, Feb. 8, 1911) and *Ostinops decumanus* (=*Cassicus cristatus* in Giebel and Piaget) (Bosca de Cupe, June 19, 1912). The specimens of Mallophaga have been deposited in the collection of the United States National Museum.

This peculiar species (pl. 32, fig. *a*) is Giebel's *Philopeterus ambiguus*, the asymmetrical character of which has passed unnoticed since its description, an oversight probably explained by the fact that this most striking feature is completely omitted in Giebel's figures, though accurately described in the text (Giebel, 1847). Piaget (1880), in redescribing the species, of which he saw no material, makes no mention of its asymmetry. Giebel's specimens were from *Cassicus cristatus*, which corresponds specifically with one of the writer's host records.

Carriker (1903) has described a species from *Zarynchus wagleri* under the name of *Nirmus francisci*, which corresponds in host species and in all characters to *P. ambiguus*, except that no mention of asymmetry is made. It is described, however, as having an emarginate clypeus and is doubtless a synonym.

The type of asymmetry exhibited in *P. ambiguus* is similar to that in *Degeeriella asymmetrica*, consisting of a rather deep clypeal emargination, appearing symmetrical in the very youngest stages,

but becoming pushed more and more to one side in the succeeding instars until, in the adult, the emargination may overlap the chitinous thickening of the side of the head (fig. *d*).

The species is strikingly marked with pitchy bands and chestnut blotches on a clear ground. The head is quite conical, a little longer than broad, with pitchy ocular and antennal bands, the latter extending forward to the anterior margin of the clypeus. The clypeal emargination is quite deep and extends obliquely from left to right; it is contained entirely within the clear, thin central portion of the clypeus, though sometimes may be pushed slightly over the chitinized margin of the head at the right; the clypeal signature is entirely lacking. The sides of the head, in front of the prominent, clear trabeculae, are concave; antennae with second segment longest and lighter in color than the three short terminal ones. The temples are broad and well rounded, and bear a long hair and three short spines; occiput almost straight with a large, prominent brown signature. The thorax is shorter and narrower than the head, with pitchy internal bands. Tarsi with one of the two claws much reduced (fig. *b*), clear and inconspicuous. Abdomen of female elliptical with pitchy lateral bands and peculiarly shaped blotches on the dorsum, which may be somewhat confused by the presence of median transverse blotches which show through from the ventral side. Genital blotch saddle-shaped (fig. *c*), broadest in front, with two small dark blotches on the posterior end and two curved, linear blotches, one on either side at about the middle. Body of male much shorter than female with more rounded abdomen. Measurements of the female are given; the male specimen appears somewhat immature.

Measurements of female.

	Length.	Width.
	mm.	*mm.*
Total	2.16	0.67
Head	.68	.58
Thorax	.37	.51
Abdomen	.98	.67

LITERATURE CITED.

1847. GIEBEL, Insecta Epizoa, p. 119, pl. 8, figs. 12 and 13.

1880. PIAGET, Les Pédiculines, p. 70.

1903. CARRIKER, Mallophaga from Birds of Costa Rica, University Studies, vol. 3, No. 2, p. 17, pl. 2, fig. 5.

1914. HARRISON, The Mallophaga as a Possible Clue to Bird Phylogeny, The Australian Zoologist, vol. 1, pt. 1, p. 3.

PHILOPTERUS AMBIGUUS GIEBEL, AN ASYMMETRICAL BIRD-LOUSE.

FOR DESCRIPTION SEE PAGES 231, 232.

A REPORT ON A COLLECTION OF HYMENOPTERA (MOSTLY FROM CALIFORNIA) MADE BY W. M. GIFFARD.

By S. A. Rohwer,

Of the Bureau of Entomology, United States Department of Agriculture.

The following paper, which is a contribution from the Branch of Forest Insects, is a report on a collection of Hymenoptera (mostly from California) which had been assembled by W. M. Giffard and received for determination through Dr. L. O. Howard. The types of all of the new species and specimens of most of the species recorded have been presented to the United States National Museum.

Considering the careful way in which Mr. Giffard has collected, it is not surprising that a number of the species proved to be new. In some of the groups the collection offered some especially interesting species which although distinct from any described species are closely allied and serve to indicate progressive modification of specific characters. Especially is this true in *Crabro* s. l.

Unless otherwise specified, all the specimens were collected by W. M. Giffard.

Suborder CHALASTOGASTRA.

Family ARGIDAE.

ARGE, species.

A species allied to *clavicornis* (Fabricius) from Eldorado County, California, 8,400 feet, June, 1909, is represented by a single female.

Family TENTHREDINIDAE.

TENTHREDELLA VARIATA (Norton).

A single male from Eldorado County, California, 8,400 feet, collected June, 1909.

STRONGYLOGASTER PACIFICA MacGillivray.

This species is represented by one female and seven males collected in Eldorado County, California, June, 1909, at an altitude of 8,400 feet.

CRATEROCERUS CALIFORNICUS, new species.

Of the described species this new species is more closely allied to *fraternalis* (Norton), but is easily distinguished from that species by size, black prescutum, etc.

Female.—Length, 6 mm. Clypeus convex, deeply, arcuately emarginate apically, the lobes rather narrow, rounded apically; supraclypeal foveae rather small, deep; supraclypeal area flat; median fovea deep, U-shaped, slightly breaking through crest; antennal foveae large, breaking through crest; pentagonal area poorly defined, trapezoidal; postocellar area, well defined on all sides, about four times as wide as the cephal-caudad length; head shining; third antennal joint a trifle shorter than the fourth; thorax shining; stigma broadest near base, tapering to apex; transverse radius received slightly basad of middle of cell; third cubital cell distinctly shorter than the second; sheath stout, strongly oblique below, rounded apically. Black; angles of pronotum and tegulae yellowish; sternites and legs below coxae piceous, paler at knees. Wings hyaline; venation dark brown, costa and stigma paler.

Type-locality.—Eldorado County, California. Described from two females collected by W. M. Giffard, June, 1909, at an altitude of 8,400 feet.

Type.—Cat. No. 19884, U.S.N.M.

Paratype in collection of Mr. Giffard.

Suborder CLISTOGRASTER.

Superfamily VESPOIDEA.

The superfamily Vespoidea is here restricted to the old Diploptera and is easily distinguished from the other groups placed in Vespoidea by Ashmead in having the posterior margin of the pronotum above and behind the anterior margin of the tegulae.

Family MASARIDAE.

PSEUDOMASARIS ALBIFRONS Rohwer.

Two males collected by A. Koebele at Tucson, Arizona, June, 1900, have the femora somewhat darker than in the type.

Family EUMENIDAE.

SYNOMORPHUS DEBILIS Saussure.

Two males from Tahoe, Eldorado County, collected June, 1909, at an altitude of 6,200 feet.

These specimens differ slightly from eastern specimens in having the dorsal aspect of the first tergite coarsely punctured, thus agreeing better with Saussure's description.

ANCISTROCERUS SEXCINGULATUS Ashmead.

Three males from Tahoe, Eldorado County, collected June, 1909, at an altitude of 6,200 feet; one male from Summit, Placer County, July, 1907.

In one specimen from Tahoe there are two small spots on the scutellum, and in the specimen from Summit these spots are present and larger.

ANCISTROCERUS SUTTERIANUS Saussure.

One male from Alameda County, collected July, 1907.

ANCISTROCERUS TAHOENSIS, new species.

This species belongs to Saussure's Group II B, p. 180, "Synopsis of American Wasps," and judging from the description must resemble *paridesi* Saussure in structure, but the abdomen is not conical and the color is quite different.

Female.—Length to apex of second tergite 8 mm. Clypeus with its length and width subequal, surface punctured to irregularly striate, the apical margin truncate; front with close almost confluent punctures; vertex more sparsely punctured, not tuberculate; angles of the pronotum prominent but not tuberculate; propodeum reticulate dorsally, finely striate posteriorly; thorax punctured like the front; first tergite transverse, almost as wide as second; second tergite twice as long as the first and not at all reflexed; first two tergites with a few small scattered punctures; somewhat obscured by the appressed pubescence. Black; clypeus except margin and a rather large median basal spot, a spot between the antennae, scape beneath, dot behind the summit of eyes, anterior margin of the pronotum, tegulae, spot beneath, two spots on the scutellum, two spots on the metanotum, apical margin of the abdominal segments (slightly broader laterally), an elongate free spot on second tergite, and legs below the knee, yellow; head and thorax with long gray hair; wings subhyaline, the apical margin dusky, basal anterior margin yellowish; costa and stigma yellow, the rest of the venation brown.

Type-locality.—Tahoe, Eldorado County, California. Described from a single female collected at an altitude of 6,200 feet, in June, 1909, by W. M. Giffard.

Type.—Cat. No. 20330, U.S.N.M.

ANCISTROCERUS LUCIDUS, new species.

This small slender species is allied to *sexcingulatus* Ashmead, but may be readily separated from Ashmead's species by the sparse punctures on the front (in *sexcingulatus* the front is closely, almost confluently punctured).

Male.—Length to apex of second abdominal segment 5 mm. Clypeus distinctly broader than long, convex, smooth, the apical margin deeply arcuately emarginate; supraclypeal area with a distinct median carina; front shining with sparse well-defined punctures; vertex not tuberculate; thorax punctured similarly to the front; the anterior margin of the pronotum carinate, the lateral angles prominent but not tuberculate; depression in front of the scutellum foveolate; propodeum reticulate dorsally; posterior face reticulate or striate; first tergite with large well-defined punctures, the second not quite twice as long and almost impunctate. Black; clypeus, spot on the mandibles, spot between the antennae, scape beneath, dot at the summit of the eyes, two spots on the pronotum, the metanotum, apical margins of the first and second tergites, tibiae, intermediate femora beneath at the apex, and the four anterior tarsi, *yellow*, flagellum brownish beneath; wings dusky hyaline; venation dark brown.

Type-locality.—Tahoe, Eldorado County, California. Described from four males collected at an altitude of 6,200 feet, in June, 1909, by W. M. Giffard.

Type and paratype.—Cat. No. 20331, U.S.N.M.

Paratypes in Mr. Giffard's collection.

ODYNERUS TRUNCATUS Provancher.

Seven males from Tahoe, Eldorado County, collected June, 1909, at an altitude of 6,200 feet.

ODYNERUS BLANDINUS, new species.

Related to *blandus* Saussure, but judging from the original description the puncturation of the abdomen in *blandus* is much stronger.

Female.—Length to apex of the second tergite, 9.5 mm. Clypeus with the length and width subequal, convex, and with sparse, well-defined punctures, the apical margin nearly truncate; supraclypeal area with a well-defined median carina; front with close, sometimes confluent punctures; vertex sparsely punctured, not tuberculate; anterior margin of the pronotum strongly carinate, the angles prominent; thorax with distinct, well-defined or confluent punctures; dorsal aspect of the propodeum punctato-reticulate, the posterior face irregularly striate and without well-defined inclosing carinae; abdomen opaque, the first segment almost impunctate, the apical margins of the second, third, fourth, and fifth tergites with closed punctures, but not at all reflex. Black; clypeus except margin and a median spot, a spot between the antennae, scape beneath, dot at summit of the eyes, anterior margin of the pronotum, tegulae, spot beneath, two spots on the scutellum, metanotum, sides of the propo-

deum, apical margins of the first and following tergites, lateral margins of the first and second tergites connected with the triangular-shaped spot, second and following sternites yellow; legs yellow; coxae above, trochanters, femora above and also beneath at base, black; tarsi ferruginous; head and thorax with short brownish hair; wings yellowish hyaline, the apical margin slightly dusky; costa and stigma yellowish, the apical venation brown.

Male.—Length to apex of the second tergite 9 mm. The male agrees very well with the female in color and structure. The clypeus is entirely yellow.

Type-locality.—Tahoe, Eldorado County, California. Described from one female and four males collected at an altitude of 6,200 feet, in June, 1909, by W. M. Giffard.

Type.—Cat. No. 20332, U.S.N.M.

Two paratypes in collection of Mr. Giffard.

Specimens which are probably this species are also collected at Summit, in Placer County, California. These specimen and a few other specimens from Eldorado County which are not considered as types indicate that this species will vary considerably in the markings of the scutellum and propodeum; most of the males have the scutellum and propodeum black; the marking of the second tergite varies somewhat, as the median yellow spots are much reduced in size in certain specimens from Summit.

ODYNERUS GIFFARDI, new species.

This species would fall near *blandus* in Saussure's Synopsis, but is easily separated from that species on the puncturation of the abdomen, and from the species described above by the yellow spot on the mesoscutum.

Female.—Length to apex of the second tergite, 7 mm. Clypeus longer than wide, irregularly striate, the apical margin truncate; front confluently punctured; vertex not tuberculate; thorax with distinct well-defined punctures, laterally bipunctate; propodeum reticulate above, posterior face striate, without defining carinae; first tergite about half as long as second, with distinct, scattered punctures; the second tergite with only setigerous punctures basally and with a few punctures apically, the apical margin not reflex. Black; clypeus except a median spot and the lateral and anterior margins, spot between the antennae, the inner margins of the eyes to the emargination, scape beneath, spot at the summit of the eyes, two spots on the pronotum, tegulae, a large spot beneath, a small dot in front of the scutellum, metanotum, large spots on the sides of the propodeum, apical margin of all the tergites, triangular-shaped lateral spots on the first and second tergites which are confluent with

the yellow lateral margin, the apical margin of the second and following sternites, basal lateral spot on the second sternite, yellow; legs black; femora beyond the middle, tibiae and the first joint of the tarsi yellow; the apical joints of the tarsi ferruginous; head with very short brownish hair; wings dusky hyaline, costa and stigma and the rest of the venation brownish.

Type-locality.—Alameda County, California. Described from five females collected July, 1907, by W. M. Giffard, for whom this species is named.

Type.—Cat. No. 20333, U.S.N.M.

Two paratypes in Mr. Giffard's collection.

A specimen from the foothills near Santa Barbara, California, collected in August, 1908, probably belongs to this species but the coxae are yellowish beneath and almost the entire second sternite is yellow.

ODYNERUS ROBUSTUS, new species.

Female.—Length to apex of the second tergite, 12 mm.; robust. Clypeus with length and width subequal, irregularly striate medianly, punctured laterally, the apical margin nearly truncate; supraclypeal area not carinate; front closely punctured; in the area adjoining the ocelli the punctures are larger and sometimes confluent; vertex more sparsely punctured, not tuberculate; anterior margin of the pronotum feebly carinate; thorax punctured similarly to the front; metanotum and dorsal surface of the propodeum coarsely reticulate; posterior face finely striate, without bounding carina; apical margin of the second tergite with large punctures, but not reflexed; apical margin of the third, fourth, and fifth tergites punctured. Black; clypeus except the lateral margin and an elongate median spot, the inner margin of the eyes to the emargination, a spot between the antennae, scape beneath, posterior margin of the eye, line on the pronotum, tegulae, a spot beneath, two small spots on the scutellum, two spots on the propodeum, apical margin of the first and following tergites, lateral median triangular spots on the first and second tergites, apical margin of the second and following sternites, broader laterally, spot on the coxae beneath, four anterior femora beneath apically, and tibiae, yellowish; tarsi ferruginous; head and thorax with dense brownish hair; wings yellowish hyaline, the apical margin dusky; venation the color of the wings.

Type-locality.—Tahoe, Eldorado County, California. Described from one female collected at an altitude of 6,200 feet, in June, 1909, by W. M. Giffard.

Type.—Cat. No. 20334, U.S.N.M.

ODYNERUS ELDORADENSIS, new species.

If it were not for the color markings, this might be the male of *robustus*, but it differs from that species as follows: Clypeus yellow,

the apical margin arcuately emarginate; scutellum, propodeum, and mesepisternum black; tergites with only the apical margin pale; tegulae almost entirely brownish. Length to apex of second tergite, 10 mm.

Type-locality.—Tahoe, Eldorado County, California. Described from one male collected at an altitude of 6,200 feet by W. M. Giffard.

Type.—Cat. No. 20335, U.S.N.M.

PTEROCHILUS MORRISONI Cresson.

One male from Tahoe, Eldorado County, collected June, 1909, at an altitude of 6,200 feet.

Superfamily MUTILLOIDEA.

The superfamily Mutilloidea as used here is that portion of the Fossores of Cresson in which the pronotum is large, well developed laterally, and extends back at least as far as the anterior margin of the tegulae and does not form a tubercule. The group is easily separated from the true Vespoids by the character mentioned under that superfamily. In the writer's opinion, the superfamily Vespoidea as defined by Ashmead is composed of a number of homogeneous groups, which it will be desirable to call superfamilies. The name Mutilloidea is used in preference to Scolioidea, which was introduced by Banks in 1912, because *Mutilla* is the older genus.

Family MUTILLIDAE.

DASYMUTILLA AUREOLA (Blake).

A single female collected by Blaisdell, July, 1910, in Calaveras County, California.

Family PSAMMOCHARIDAE.

PSEUDAGENIA METALLICA Banks.

A female from Alameda County, California, July, 1907.

PEPSIS FORMOSA (Say).

Two of each sex collected by Blaisdell in Calaveras County, California, July, 1910.

PSAMMOCHARES, species.

A single female from San Francisco, California, July, 1907, does not seem to be described.

PSAMMOCHARES AETHIOPS (Cresson).

A male from Alameda County, California, July, 1907.

PSAMMOCHARES LUCTUOSUS (Cresson).

One female and two males from Tahoe, Eldorado County, California, June, 1909.

APORINELLUS CALIFORNICUS, new species.

This species appears to be more closely allied to *Aporinellus ferrugineipes* (Viereck), but does not agree with the description of that species, being easily differentiated by the red four anterior legs, relationship of antennal joints, and arcuation of the pronotum.

Female.—Length, 6 mm. Anterior margin of clypeus truncate; malar space very narrow; inner margin of eye broadly arcuately marginate about the middle; ocelli in a low triangle; postocellar line one-fifth longer than the ocellocellar line; antennae slightly tapering, third and fourth joints subequal; head shining; pronotum shallowly arcuately emarginate posteriorly; entire thorax shining; dorsal aspect of propodeum with a distinct median furrow; longer calcaria of both the intermediate and posterior tibiae distinctly more than half as long as basitarsus, that on the intermediate tibiae slightly longer in proportion than the one on posterior tibiae; radial cell very short; second cubital cell trapezoidal in outline; second recurrent nearly interstitial with second transverse cubitus; the first recurrent one-third of the length of the cell from the first transverse cubitus; nervulus slightly antefurcal; abdomen shining. Black with very little pubescence; mandibles except apices, anterior margin of clypeus, all of the femora and tibiae, and basal part of all of the basitarsi rufus; wings hyaline; venation pale brown.

Type-locality.—Alameda County, California. Described from one female collected July, 1907, by W. M. Giffard.

Type.—Cat. No. 19967, U.S.N.M.

Superfamily SPHECOIDEA.

Family SPHECIDAE.

CHLORION CYANEUM Dahlbom.

Two females from Ohio or Texas.

PALMODES LAEVIVENTRIS (Cresson).

One male from the foothills of Santa Barbara County, California, August, 1907.

AMMOBIA PENSYLVANICA (Linnaeus).

Two males from Ohio or Texas.

AMMOBIA ICHNEUMONEA (Linnaeus).

One female and one male from Ohio or Texas; one of each sex from San Rafael, California, August, 1909; one male from Calaveras County, California, July, 1910, collected by Blaisdell.

SCELIPHRON SERVILLII Lepeletier.

A specimen of each sex from the foothills of Santa Barbara County, California, August, 1907.

PSAMMOPHILA LUCTUOSA Smith.

Three females from Tahoe, Eldorado County, California, 6,200 feet, June, 1909; one female from Alameda, California, July, 1907; one female from Summit, Placer County, California, 7,000 feet, July, 1907.

PSAMMOPHILA VIOLACEIPENNIS Lepeletier.

Two females from Tahoe, Eldorado County, California, 6,200 feet, June, 1900; and one male from Alameda, California, July, 1907.

SPHEX SAEVA (Smith).

One female collected by Blaisdell in Calaveras County, California, July, 1910.

SPHEX VULGARIS (Cresson).

Three of each sex from Tahoe, Eldorado County, California, 6,200 feet, June, 1909.

OXYBELUS, species.

A single female specimen from the coast of Santa Barbara collected June, 1907, appears to represent a new form, but more material is needed.

OXYBELUS QUADRINOTATUS Say.

Two females and four males from San Francisco, July, 1907; two males from the Santa Barbara coast June, 1907; two females and two males from Alameda County, July, 1907. These specimens are rather larger than the eastern form, and have the abdomen more closely punctured.

LINDENIUS COLUMBIANUS Kohl.

Two females and 12 males from Santa Barbara, California, July, 1907.

These specimens agree very well with Kohl's description, but it is impossible to make the comparison with *pygmaeus*. This species is easily distinguished from *errans* Fox by the more closely punctured scutum and by the unusually prominent lateral ridges of the scutum.

Genus SOLENIUS Lepeletier.

Subgenus HYPOCRABRO Ashmead.

Syn.: *Pseudocrabro* ASHMEAD.
Xylocrabro ASHMEAD.

The groups for which *Hypocrabro* and *Pseudocrabro* were purposed can not be separated in the female (Ashmead's separation was

based entirely on the types, and according to his characters the female of *packardii* would be a *Pseudocrabro*, while the male would be a *Hypocrabro*), so it is evident they must not be considered as distinct. *Xylocrabro* Ashmead (= group *scaber* Fox) is in habitus rather different from *Hypocrabro* and can be well differentiated in most species by the presence of a foveolate channel on lateral posterior angle of the propodeum, coarser sculpture, and absence of a fringe at the side of the pygidium. In certain species, however (such as *banksi* Rohwer), there is intergrading (*banksi* has habitus and punctuation of *Xylocrabro* and other characters of *Hypocrabro*), so it is difficult to satisfactorily separate the two groups. For this reason the above synonymy is preferred.

SOLENIUS (HYPOCRABRO) IMBUTUS (Fox).

Crabro imputus Fox, Proc. California Acad., ser. 2, vol. 4, 1894, p. 108.

Crabro (*Solenius* Lepeletier) *ferrugincipes* ROHWER, Ent. News, vol. 19, 1908, p. 250.

From material in the United States National Museum it is evident that *ferrugincipes* Rohwer is only a color form of *imbutus* Fox, in which the sternites are black, the spot on the first tergite is wanting, and the spots on the second tergite are much reduced.

SOLENIUS (HYPOCRABRO) NOKONIS (Rohwer).

Crabro (subg. ?) *nokonis* ROHWER, Ent. News, 1908, vol. 19, p. 251.

This species is very close to *chrysarginus*, but may be distinguished, as far as the material in the United States National Museum goes, by the black metanotum and prepectus.

SOLENIUS (HYPOCRABRO) GIFFARDI, new species.

The female of this species runs in Fox's synopsis to *packardii* Cresson, to which it is very closely allied, but it may be differentiated from *packardii* by the richer livery, the shorter first flagellar joint, and the less strongly ridged pronotum. The male runs to copulet 25 and differs from *imbutus* in markings and sculpture and from *odyncroides* by the marks on the sternites and shorter first joint of the median tarsus.

Female.—Length 11.5 mm. Clypeus with low median projection, the lateral angles of which are round; distance between the eyes at the clypeus about one-fifth greater than the median length of the clypeus; frons very closely punctured, almost granular; vertex and posterior orbits with the punctuation more distinct; ocelli in very low triangle; postocellar line about one-eighth shorter than the ocellocular line; first joint of flagellum one-fifth longer than the second; pronotum not strongly ridged and without a lateral tooth; mesonotum closely punctato-granular, posteriorly the punctures are

more distinct; scutellum with close irregular punctures; mesepisternum striato-punctate; episternal groove scarcely foveolate; propodeum with a distinct median channel, dorsally striato-punctate, posteriorly obscurely reticulate, laterally finely rugulose; abdomen shining; the first tergite with punctures a trifle larger and more separate than any of the following; venation, legs and pygidium typical of group. Black; mandibles except apically, two obscure small spots on the clypeus, scape, pedicellum, two large spots on pronotum (almost contiguous), tubercules mesepisternum anteriorly, scutellum, two small spots before the scutellum, a line on metanotum, a broad band on all of tergites near anterior margin (interrupted narrowly on third), second sternite medianly, third sternite laterally, and sixth sternite medianly bright *yellow;* legs yellow, coxae, trochanters, and femora above (posterior femore beneath), and apical four joints of hind tarsi black; wings dusky hyaline; venation pale brown; with the usual short pressed silvery pubescence; the head, thorax and first tergite with rather long slightly yellowish hair.

Male.—Length 10 mm. First joint of flagellum one-fifth longer than second; mesoscutum and propodeum more distinctly punctured than in the female; differs from the female in having most of the four posterior femora black.

Type-locality.—Alameda County, California. Described from three females (one type) and two males (one allotype), collected in July, 1907, by W. M. Giffard, for whom the species is named.

Type.—Cat. No. 20156, U.S.N.M.

A male and female paratype in Mr. Giffard's collection.

SOLENIUS SEPTENTRIONALIS (Packard).

A male and female from Summit, Placer County, California, collected July 1907 at an altitude of 7,000 feet.

BELEPHARIPUS ATER (Cresson).

A single female from Tahoe, Eldorado County, California, 6,200 feet, June 1909.

CRABRO LATIPES Smith.

Five males from Summit, Placer County, California, 7,000 feet. July 1907.

CRABRO LARGIOR Fox.

One female from Tahoe, Eldorado County, collected June 1909 at an altitude of 6,200 feet.

CRABRO VICINUS Cresson.

Two females from Summit, Placer County, collected July 1907; and two females from Tahoe, Eldorado County, collected June 1909 at an altitude of 6,200 feet.

ANTHOPHILUS MULTIMACULATUS Cameron.

One female and six males from the Santa Barbara coast, June 1907.

ANTHOPHILUS PACIFICUS (Cresson).

Five males from Alameda County, California, July 1907; three males from the Santa Barbara coast, June 1907.

CERCERIS FINITIMA Cresson.

Thirty-one males from the coast and two from the foothills of Santa Barbara County, California. Specimens collected in June and August 1907.

CERCERIS CALIFORNICA Cresson.

One male from Calaveras County, California, collected July, 1910, by Blaisdell agrees fairly well with Cresson's description.

LARROPSIS TENUICORNIS (Smith).

A single male specimen from Alameda County, California, July, 1907, is not quite typical, as the striae on the propodeum curve anteriorly.

TACHYSPHEX TERMINATUS (Smith).

One female and three males from Alameda County, California, July, 1907; and one male from the foothills of Santa Barbara, California, collected August, 1907. No differences between these and New Jersey specimens were found.

TACHYSPHEX GIFFARDI, new species.

In Fox's Revision of the North American Larridae this species traces to *montanus* Cresson, but differs in clypeal characters, color, etc. From *tarsatus* Say, *hitei* Rohwer, and *semirufus* Cresson the punctuation will distinguish.

Female.—Length, 8 mm. Clypeus strongly convex, shining, with large separate punctures, the anterior margin subtruncate, the lateral angles not or but slightly produced; frons opaque, granular with distinct separate punctures in addition; above the anterior ocellus the granulation is much finer and the punctures closer and better defined; the superior interocular line much more than half the inferior interocular line, greater than the length of antennal joints two plus three but less than three plus four; antennae scarcely tapering, the third and fourth joints subequal; scutum and scutellum shining, with distinct scattered punctures which are closer and finer on the scutum anteriorly; dorsal aspect of the propodeum coarsely granular; mesoplurae and sides of propodeum coriaceous; posterior face of the propodeum transversely striated, the dorsal stria being more promi-

nent; the first two abcissae of radius subequal, the third a trifle shorter; abdomen shining, without apparent sculpture; pygidium one and one-third times as long as basal (base of lateral carinae) width. Black, abdomen clear red; head and thorax with a small amount of silvery pile; wings dusky hyaline.

Type-locality.—Summit, Placer County, California. Described from six females collected in July, 1907, by W. M. Giffard, for whom the species is named.

Type.—Cat. No. 19927, U.S.N.M.

Two paratypes in Mr. Giffard's collection.

TACHYSPHEX ELDORADENSIS, new species.

In Fox's table this will go to *consimilis* Fox, but it is larger and the abdomen is all red. It is closely allied to *giffardi* Rohwer, but is larger and the mesoscutum is much more coarsely sculptured. *Eldoradensis* is most closely allied to *neomexicanus* Rohwer, but may be separated by the much longer pydidium.

Female.—Length 11 mm. Clypeus strongly convex, shining with large separate punctures, the anterior margin subtruncate (slightly wavey) the lateral angles not at all produced; frons coarsely coriaceous; intraocellar area with separate distinct punctures, the vertex similarly but more closely punctured; superior interocular line about half as long as the inferior, distinctly longer than the second and third antennal joints but markedly less than the third and fourth: antennae slightly tapering, the third joint one-fifth shorter than the fourth; mesoscutum punctured similar to vertex; scutellum shining more sparsely punctured, not impressed; dorsal aspect of propodeum coriaceous, the sides finely striato-granular, the posterior face distinctly transversely striate; the first and third abcissa of radius subequal, the second much shorter; abdomen shining, without apparent sculpture, the pygidium three times as long as basal (base of lateral carinae) width. Black; abdomen clear red; tarsi reddish; pubescence silvery; wings dusky hyaline.

Type-locality.—Tahoe, Eldorado County, California. One female collected at an altitude of 6,200 feet, June, 1909, by W. M. Giffard.

Type.—Cat. No. 19928, U.S.N.M.

TACHYSPHEX PLESIA, new species.

In Fox's synopsis this will fall in with *fumipennis*, but, judging from the description, it is not closely allied to that species.

Female.—Length 8 mm. Clypeus convex, shining, with distinct separate punctures; the anterior margin with a broad, low, depressed lobe which is gently rounded; frons coarsely punctato-reticulate: intraocellar area with separated punctures; vertex with scattered

punctures; superior interocular line nearly half as long as the inferior and subequal with the second, third, and fourth antennal joints; antennae filiform, the third joint one-fourth shorter than the fourth; mesoscutum punctured similar to the vertex; dorsal aspect of the propodeum coarsely coriaceous, the sides finely striate, the posterior face more strongly striate; second abcissa of radius longer than first or third; pygidium sharply narrowing, the carinae almost obsolete, length and basal (base of carinae) width subequal. Black; first two and last tergites piceous; wings dusky hyaline; pubescence sparse and silvery.

Type-locality.—Tahoe, Eldorado County, California. Described from two females collected at an altitude of 6,200 feet June, 1909, by W. M. Giffard.

Type.—Cat. No. 19950, U.S.N.M.

Paratype in Mr. Giffard's collection.

TRYPOXYLON FRIGIDUM Smith.

One male from Piedmont or Oakland, California, collected October, 1910.

TRYPOXYLON ARIZONENSE Fox.

One female collected by Blaisdell, in Calaveras County, California, July, 1910.

CERATOPHORUS TENAX (Fox).

Two females and four males from Piedmont and Oakland, California, collected September, 1910. Four females and six males from Alameda County, California, collected July, 1907.

PEMPHREDON NEARCTICUS Kohl.

A single female from Tahoe, Eldorado County, June, 1909, elevation 6,200 feet.

CEMONUS GIFFARDI, new species.

In Fox's table[1] this species will run to *tenax*, but the clypeus and propodeum readily separate the two species.

Female.—Length, 7.5 mm. Anterior margin of the clypeus with a broad median projection, the apex of which is shallowly arcutely bemarginate, so there are three small teeth; front rather sparsely punctures with a tendency to striato-punctation above the antennae; vertex and posterior orbits shining, sparsely punctured; antennae nearly filiform, the third joint slightly longer than the fourth; mesoscutum and scutellum polished with a very few distinct punctures; mesepisterum coarsely coriaceous to striate; sides of the propodeum striato-reticulate, dorsad-ventrad; dorsal aspect

[1] Trans. Amer. Ent. Soc., vol. 19, 1892, p. 308.

of propodeum with distinct carinae basally, which become so reduced posteriorly that there is a semicircular nearly unsculptured area; posterior aspects of propodeum punctato-striate; petiole convex above, coarsely sculptured slightly longer than hind coxa and femora or dilated part of first tergite; gaster polished; nervulus slightly antefurcal; second recurrent slightly antefucal; second cubital narrowed by a fifth below. Black sparsely clothed with long white hair; wings hyaline, dusky apically; ventation dark brown.

Type-locality.—Alameda County, California. Described from one female collected July, 1907, by W. M. Giffard.

Type.—Cat. No. 20129, U.S.N.M.

STIGMUS FULVIPES FULVIPES Fox.

One female and four males from the foothills near Santa Barbara, June, 1907.

STIGMUS FULVIPES COQUILLETTI Rohwer.

One female from Alameda County, California, collected July, 1907.

DIPLECTRON BIDENTATUS Ashmead.

One male from Alameda County, collected July, 1907.

This differs from Ashmead's type, which is a male (not female), in that the white mark on the side of the face is larger and the scape is pale beneath. This is new to California.

SILAON AFFINIS (Rohwer).

One female from Alameda County, collected July, 1907.

This is slightly smaller than the type, the mandibles are ferruginous, and the anterior tibiae have a pale spot exteriorly.

SILAON MAJOR, new species.

May be readily separated from the other American species of this genus by its large size, dark legs, and by the striation of the propodeum.

Female.—Length, 10 mm. Anterior margin of the clypeus obtusely, triangularly produced and with eight or nine strong, short spines; frontal carina strong, extending from the apex of the clypeus dividing a short distance above the antennae becoming subparallel and then sharply diverging to the inner margins of the eyes which it approximates and parallels from the anterior ocellus to the line drawn tangent to the posterior ocelli; head opaque, with fine, close punctures; ocelli in acute triangle; the ocellocular line sub-

equal with the diameter of a lateral ocellus; vertex and posterior orbits more sparsely punctured than the front; antennae tapering apically, the third joint one-fifth longer than the fourth; fourth and fifth subequal; distance between the eyes at the vertex slightly greater than the length of the second and third antennal joints: mesoscutum with distinct, well-defined punctures which become confluent laterally; scutellum similarly punctured; mesepisternum coarsely granular; dorsal aspect of the propodeum with oblique striae except in the apical middle where the striae are transverse, and there is a median longitudinal carina; sides of the propodeum strongly, irregularly longitudinally striate; posterior face truncate, transversely striate; nervulus slightly beyond the basal; second cubital receiving both recurrent veins at a distance from the transverse cubiti subequal with the length of the petiole of the second cubital; legs hardly spined, longer calcarium of the posterior tibia half as long as the posterior basitarsus; pygidial area with small, separate, well-defined punctures. Black; abdomen rufous; apical joints of the tarsi rufo-piceous; wings hyaline with the apical margin dusky; venation dark brown; head and thorax with dense, silvery pile; apical margin of the first four tergites with dense, silvery pile.

Type-locality.—North Yakima, Washington. Described from one female collected July 14, 1903, by Eldred Jenne.

Type.—Cat. No. 18998, U.S.N.M.

Male.—What is probably the male of this species was collected in Alameda County, California, July, 1907, by W. M. Giffard. It agrees very well in the above description of the female, but the following characters may be added: Length, 6 mm. Clypeus carinate, produced into a truncate lobe which is again produced into a low, rounded lobe; antennae distinctly tapering, the joints short, the third about one-fifth longer than fourth.

This male is not considered part of the type material.

HOPLISUS HAMATUS (Handlirsch).

One male from Tahoe, Eldorado County, collected June, 1909, at an altitude of 6,200 feet.

HOPLISUS ATRIFRONS (Fox).

Three males from Tahoe, Eldorado County, California, 6,200 feet, June, 1909.

DIENOPUS HOWARDII (Ashmead).

One male from Summit, Placer County, California, July, 1907.

NYSSON RUSTICUS Cresson.

One female from Tahoe, Eldorado County, collected June, 1909, at an altitude of 6,200 feet.

NYSSON (BRACHYSTEGUS) PACIFICUS, new species.

In Fox's table [1] falls next to *punilus* (Cresson), but that species has the mesoscutum finely punctured and is otherwise different. In Cresson's table [2] falls in with *compactus* Cresson, but that species has, according to Fox, quite different venation.

Male.—Length, 5 mm. Anterior margin of the clypeus depressed, broadly rounded, the basal portion convex with a few shallow punctures; eyes one-third closer together at the clypeus than at the vertex; front with close fine punctures and in addition larger and deeper punctures in the middle; postocellar line subequal with the ocellocular; interocellar area not raised or tuberculate; flagellum thickening apically, the apical joint subequal in length with the two preceding, obliquely truncate; pronotum rounded; mesoscutum bipunctate, the larger punctures close and sometimes partly confluent; punctures of the scutellum largely confluent; dorsal aspect of propodeum with about 10 longitudinal carinae; spines prominent, acute; legs normal; nervulus postfurcal by more than half its length; nervellus antefurcal by its length; abdomen very finely granular and in addition with distinct separate punctures. Black; first tergite except median apical spot ferruginous; median spot on pronotum, tubercules, lateral spots on first fourth tergites (larger on first), yellowish-white; mandibles and anterior tibiae and tarsi piceous. Clothed with the usual silvery pile which is especially dense on the lateral dorsal aspect of the propodeum; wings dusky hyaline; venation brown.

Type-locality.—Foothills near Santa Barbara, California. Described from one male collected August, 1907, by W. M. Giffard.

Type.—Cat. No. 20162, U.S.N.M.

Family BEMBICIDAE.

STENIOLA DUPLICATA Provancher.

One female collected by A. Koebele at Tucson, Arizona, June, 1900.

BEMBIX SPINOLAE Lepeletier.

One female from Ohio or Texas.

SPHECIUS SPECIOSUS Drury.

One female from Ohio or Texas.

Superfamily APOIDEA.

XYLOCOPA ORPIFEX Smith.

A male and female from Calaveras County, collected by Blaisdell, July, 1910.

[1] Journ. N. Y. Ent. Soc., vol. 4, 1896, p. 12.
[2] Trans. Amer. Ent. Soc., vol. 9, 1882, p. 273.

A NEW SPECIES OF BEAR-ANIMALCULE FROM THE COAST OF NORTH CAROLINA.

By W. P. Hay,

Of the Washington (District of Columbia) High Schools.

For many years the presence of marine species of tardigrades, or bear animalcules, on the coasts of Europe has been known to the scientific world. In 1851 Dujardin described[1] a remarkable, very minute species, now known as *Microlyda dujardini* (Plate), which had been discovered two years previously at St. Malo, in northern France. In 1865 Schultze described[2] the species now known as *Echiniscoides sigismundi* (Schultze) which he had found at Ostend. In 1892 Cuénot found at Roskoff, in northern France, a species which he described[3] under the name *Tetrakentron synaptae*, the creature being a parasite of *Synapta inhaerens*. In 1904 Prof. F. Richters discovered at Kiel and at Bergen, respectively, two marine species of the genus *Macrobiotus* to which he gave the names *Macrobiotus stenostomus* and *M. appellöfi*[4]. In 1907 the same indefatigable student of these microscopic animals, while working at Cancale, found another tardigrade which he described[5] as *Halechiniscus guiteli* and in 1909, at Kiel, still another to which he gave the name *Batillipes mirus*.[6]

Having kept in touch with the literature of this group it appeared probable to the writer that some of these animals should appear on the American Atlantic coast, and at the first opportunity a search for them was begun. During the summer of 1911, while engaged, at Beaufort, North Carolina, in the study of the decapod crustaceans of the region, material was collected from time to time and examined for tardigrades. The material, as a rule, consisted of the washings from masses of seaweed, but occasionally the ooze from various parts of the harbor was obtained. Finally, on September 6, some washings from a large patch of *Dictyota* were examined and were found to contain hundreds of tardigrades belonging to the genus *Batillipes*.

[1] Ann. Sci. Nat., ser. 3, vol. 10, pp. 158–173.
[2] Arch. f. mikro. Anat., vol. 1, p. 428.
[3] Rev. Biol. du Nord de la France, vol. 5, p. 16, pl. 1.
[4] Zool. Anzeig., vol. 33, p. 84.
[5] Idem, p. 81.
[6] Ber. der Senckenb. Naturf. Gesell., 1909, p. 37, pl. 2.

The live animals were carefully studied, the details of their external structure were drawn, and a description was written, but before publishing it it appeared to be desirable to ascertain certain facts about the European species. A letter to Professor Richters brought a prompt reply in the form of a mounted specimen of *B. mirus*, several microphotographs, and a letter suggesting a reexamination of certain details of structure. For proper examination living specimens were necessary and a wait of a year was inevitable.

In 1912 and 1913 and again in 1914 only a single specimen was found and time was lacking to complete the work. In 1915 several specimens were obtained, but so late in the season that an unsatisfactory examination only was possible. In 1916 the writer was unable to visit the type-locality, and as it may be several years before he can return, it seems advisable to present what has been ascertained regarding the animal. It may be known by the following description:

BATILLIPES CAUDATUS, new species.

Plate 33.

Holotype.—Cat. No. 49639 U.S.N.M., and paratypes Cat. No. 49640 U.S.N.M., from Beaufort, North Carolina, collected September 6, 1911, from *Dictyota*, obtained from the jetties at the western end of Shackleford Bank.

Body stout, plump and covered with a finely-granulate, almost transparent skin. Head broad, flattened, and bearing seven cirri, one of which is situated on the median line of the top of the head some distance in front of the eyes; another (paired) is on the frontal border a little to one side of the middle line; another (paired) is below the frontal border about on a line with the mouth and another (paired) is on the lateral border about on a line with the eyes; all the cirri, with the possible exception of the pair near the mouth, spring from papillae and the last one bears at its base an elongate, thin, somewhat triangular flap. The eyes are small and almost colorless. The margins of the body project beyond and somewhat overhang the bases of the legs. On each side near the posterior end there is a slender cirrus and the body terminates in a small, acuminate tail-like process.

The legs consist of a stumpy basal portion into which the much smaller foot may be partially telescoped. Each leg of the last pair has a stout spine on its posterior surface. The foot consists of a small, knob-like piece to which are attached five, occasionally six, slender toes which are abruptly expanded at their distal ends into thin shovel-like portions.

The mouth is situated on the ventral surface of the head and opens into a slender esophagus on each side of which is a very small and slender tooth. The teeth do not appear to be forked at their

upper ends nor have bearers been detected. The pharynx is small, nearly spherical and does not appear to contain chitinous thickenings. The pharynx opens directly into the large, irregularly lobate stomach. The reproductive organ lies above the stomach. It is a large, fusiform structure which begins a little in front of the middle of the body and extends back nearly to the hind legs where it turns abruptly downward to join the posterior end of the stomach. The anal opening has the appearance of a small, round papilla on the ventral surface immediately in front of the last pair of legs. The muscle bands underlying the epidermis of the body and those extending into the legs are quite conspicuous.

In all the specimens examined the stomach is filled with a yellowish or greenish-brown mass evidently of vegetable origin and there can be no doubt that the animal devours the seaweed on which it occurs. In some of the specimens the reproductive organ appears to contain eggs but their outline is so indefinite that it is unsafe to state their number or character. In most cases the reproductive organ contains a granular mass the nature of which is not evident.

The species at hand resembles *B. mirus* Richters in all important characters but appears to differ markedly in the presence of eyes, the character of the sense organ at the base of the lateral cirrus of the head, the presence of the lateral cirri near the posterior end of the body and in having more slender toes with smaller terminal expansions.

In Professor Richters' original description of *B. mirus* the median frontal cirrus is not mentioned nor is the posterior tail-like process although the latter is plainly shown in the microphotograph which accompanies the description. In a subsequent article[1] the statement is made that the posterior cirri are represented by strong spines and these are shown in the figure. The frontal cirrus and the median posterior process are neither mentioned nor shown in the figure. In the separate of this paper, however, which was received from Professor Richters the statement concerning the posterior strong spines has been struck out and in a manuscript note the tail-like process is described. In the figure also Professor Richters has added the median frontal cirrus and a papilla at the base of the first pair of cirri.

The specimen of *B. mirus* which, thanks to Professor Richters, I have been able to examine, is mounted on a slide in such a position that most of the cirri in question can not be clearly discerned, but I strongly suspect that *B. mirus* and *B. caudatus* will be found to be more alike than they are now believed to be. The posterior pair of setae in *B. caudatus* are extremely delicate and, perhaps because they

[1] Verh. d. Deutsch. Zool. Gesell., vol. 19, 1909, pp. 84–94, pl. 3, fig. 5.

have been broken off, can not be found in every specimen; for the same reason they may have been overlooked in *B. mirus*. The papilla at the base of the first lateral cirrus does not appear to be present in *B. caudatus* at all. The sense organ at the base of the last lateral cirrus is described as rod-shaped or club-shaped in *B. mirus*. In preserved specimens of *B. caudatus* it has the appearance of a rod but on close examination proves to be a thin flap with a slight spiral twist. In *B. mirus* there is some evidence that the sense organ is similarly formed.

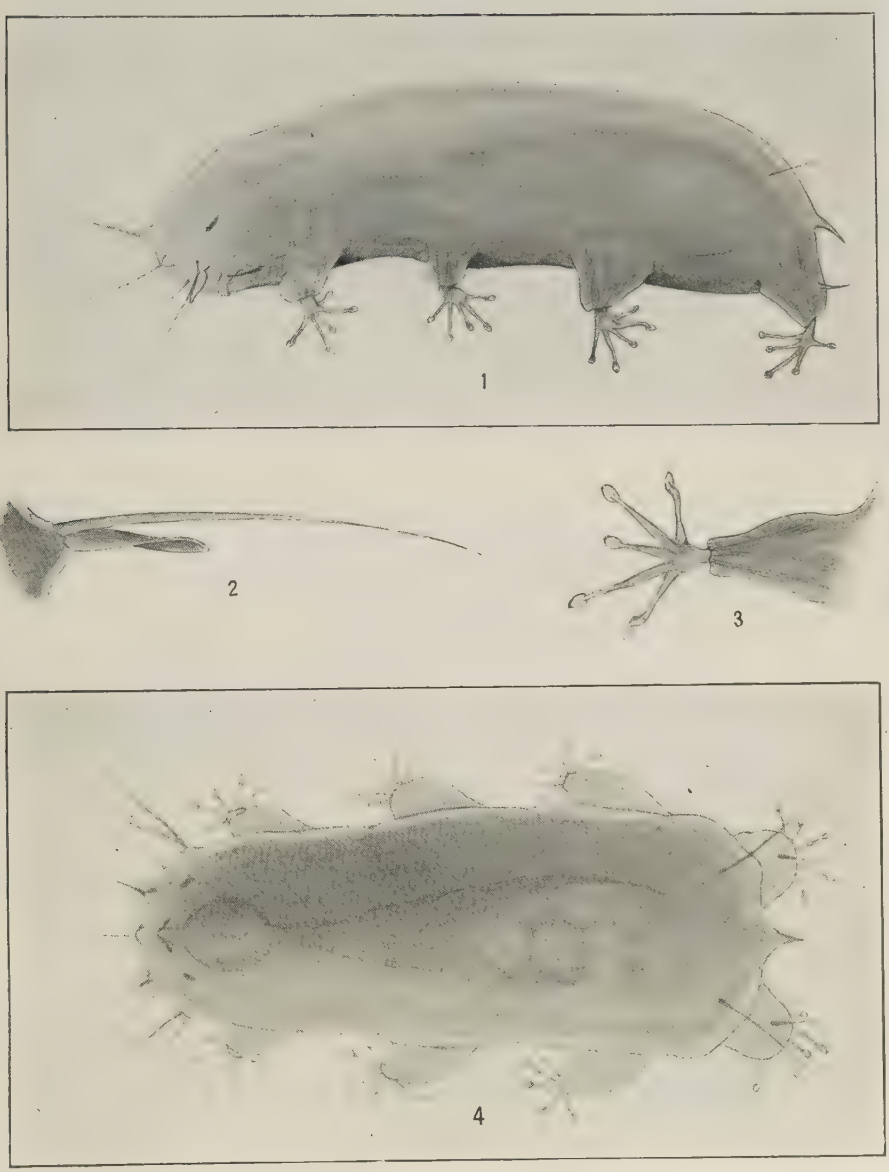
The marine tardigrades are of special interest, as has been pointed out by Professor Richters in the articles already cited, in that they furnish conclusive evidence that the group Xenomorphida (=Tardigrada of most writers) is an offshoot from the chaetopod worms and is not at all closely related to the Arachnida near which it is placed in nearly every textbook on zoology. The legs of the bear animalcules are properly to be regarded as modified parapodia and the claws and toes are specialized setae. The cirri of the head, especially those of *Halechiniscus* and *Batillipes* find their counterparts only among the Chaetopoda.

Five exclusively marine genera of bear animalcules are now known. A sixth, *Macrobiotus* contains at least two species which live in the ocean, several which inhabit fresh water, and a number which are terrestrial. The genus *Milnesium* is represented by only one species and this inhabits fresh water. The genus *Diphascon* contains aquatic (fresh water) and terrestrial species. The genera *Oreella* and *Echiniscus*, the former with one and the latter with forty or fifty species, are terrestrial and are found on moss and lichens. Thus of the ten known genera, six are wholly or partly marine and only two are strictly terrestrial. This fact points strongly to a marine origin for the group and, taken in conjunction with the homologies pointed out by Professor Richters, goes far to support his belief as to its affinities.

EXPLANATION OF PLATE 33.

Batillipes caudatus Hay.

FIG. 1. Lateral view.
2. Large lateral cirrus of head with flap-like appendage at its base.
3. Detail of foot.
4. Female, dorsal view.



A NEW BEAR-ANIMALCULE FROM NORTH AMERICA.

FOR EXPLANATION OF PLATE SEE PAGE 254.

A NEW AMERICAN PARASITE OF THE HESSIAN FLY (MAYETIOLA DESTRUCTOR SAY).

By P. R. Myers,

Of the Bureau of Entomology, United States Department of Agriculture.

During the course of some biological investigations of the parasites of the Hessian fly, *Mayetiola destructor* Say, by Mr. W. R. McConnell and the author, a parasite new to America was reared from puparia in great abundance. This parasite runs to *Polygnotus* Förerster in Ashmead's key (Monograph of the North American Proctotrypidae). It was compared with specimens of European Proctorypoid parasites of the Hessian fly in the United States National Museum collection, some of which are labeled *Platygaster minutus* Lindeman and others, *Polygnotus* (*Platygaster*) *minutus* Lindeman. This European material represents two distinct species. The specimens labeled *Platygaster minutus* Lindeman were sent from Russia and are probably paratypes of Lindeman's species. These specimens are closely related to our *Polygnotus hiemalis* Forbes but are distinct from those labeled *Polygnotus* (*Platygaster*) *minutus* Lindeman and the new species described in this paper. The specimens standing as *Polygnotus* (*Platygaster*) *minutus* Lindeman are labeled "France" and were probably determined by Ashmead. One of these specimens has "*zosine?*" written at one end of the label. These specimens are apparently the same as the specimens described as a new species in this paper. This new parasite will be found to compare somewhat favorably with the original description of *Platygaster zosine* Walker, but his description is too brief and indefinite to enable the writer to determine whether or not the material before him represents Walker's species. Because of the difficulty encountered in securing authoritatively named material or having comparisons made with the types of European species at the present time on account of the unsettled conditions in Europe, it has been decided to describe this American Hessian fly parasite as a new species, since it is necessary that we should have a specific name for use in the notes relating to our investigations. In the writer's opinion, this new parasite may prove to be *Platygaster zosine* Walker, and in that case it was probably introduced by in Riley 1891 with *Pleurotropis* (*Entedon*) *epigonus* (Walker) Riley, if indeed it had not already been introduced previous to that time.

POLYGNOTUS VERNALIS, new species.

Female.—Length about 1.36 mm.; black and shining; front, vertex, occiput, and cheeks transversely rugulose and bare; mandibles fusco-testaceous, a few long, scattered, whitish hairs on clypeus and mandibles; eyes black; antennae 10-jointed, fusco-piceous; scape about as long as the four apical joints, longitudinally rugulose, with a few scattered whitish hairs; pedicel oblong globose, nearly as long as first and second joints of the flagellum, pubescence sparse; first and second joints of flagellum cylindrical, closely united, narrowest of all joints, pubescence sparse; remaining joints granose, rounded at base and truncate at apex, apical joint longest of all; third and fourth joints subequal, shortest of all, pubescence sparse; joints 5, 6, 7 thickest of all, rather densely pubescent and forming the club; pronotum shining, bare, reticulose, mesonotum shining, bare, indistinctly aciculated longitudinally; scutellum convex, smooth and polished, distinctly margined, very faintly aciculated, and sparsely pubescent, foveae at base widened laterally, narrowed medially; parapsidal furrows very indistinct; propleurae shining and transversely aciculated; mesopleura smooth and polished with transverse curved aciculations dorsally; metapleura shining with dense whitish pubescence; propodeum with two broad, rugose, median carinae and a transversely striated knob at the apex, with long whitish pubescence except on the knob and between the carinae; lateral carinae distinct; petiole dorsally sulcate, its base flared especially dorsally to receive knob on propodeum, densely pubescent except in sulcus; abdomen ovate, smooth and highly polished, second segment very long, with two shallow, dorsal concave areas at the base, base hairy; four remaining segments very short, a fringe of fine hairs on apex; coxae black, trochanters fusco-piceous, femora black, tibiae black except anterior tibiae which are fusco-piceous at base and apex, tarsi dark testaceous on middle and posterior legs, a little lighter on the anterior legs, all apical tarsal joints black; all tibiae and tarsi with white pubescence; all femora and tibiae aciculated; wings hyaline, very long, about two and a half times as long as the abdomen.

Allotype.—Essentially the same as the type; second joint of flagellum dilated; apex of abdomen not quite so pointed as in female; all tarsi fusco-piceous. Antennae 10-jointed. Length, 1.04 mm.

This species may be easily distinguished from *Polygnotus hiemalis* Forbes by the transversely rugulose head, the long wings, long, slender legs and the body generally of less robust form.

Type.—Cat. No. 21135, U.S.N.M.

Type and allotype locality.—Hagerstown, Maryland.

Paratype localities.—Pennsylvania: Andersonburg, Butler, East Waterford, Ford City, Greensburg, Hellertown, Indiana, Lansdale,

Lenape, Lewisburg, Linden, Marysville, Middleburg, Montgomery, Montoursville, Muncy, Northumberland, Pennbrook, Sellersville, Red Lion, Vicksburg, Warfordsburg. Virginia: Berryville, Front Royal, Strasburg. West Virginia: Charlestown, Martinsburg.

Described from 12 females and 17 males. Types in United States National Museum collection. All specimens were reared from Hessian Fly puparia collected at the above-mentioned localities during the summer of 1915, by W. R. McConnell and the author.

CUBAN AMPHIBIANS AND REPTILES COLLECTED FOR THE UNITED STATES NATIONAL MUSEUM FROM 1899 TO 1902.

By Leonhard Stejneger,

Head Curator, Department of Biology, United States National Museum.

Shortly after the war with Spain for the liberation of Cuba several members of the staff of the United States National Museum visited the island for the purpose of making collections of natural history specimens.

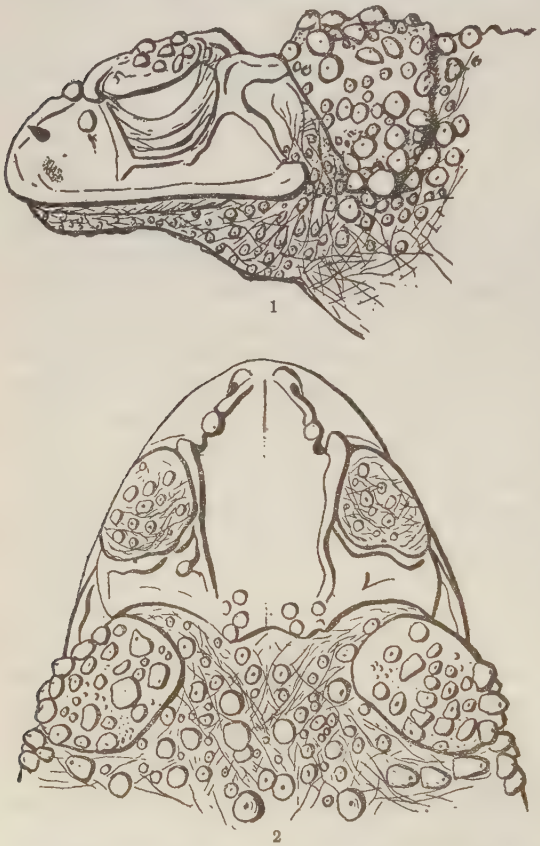
The principal expedition was that of Messrs. William Palmer and J. H. Riley, who collected in western Cuba, between Matanzas and Pinar del Rio, from February 14 to August 7, 1900, including a stay at Nueva Gerona, Isle of Pines, from June 27 to July 11. The most important reptile collections were made at Pinar del Rio and in a locality called El Guamá, about 6 miles northwest of the city of Pinar del Rio from February 18 to March 29; at San Diego de los Baños, from April 4 to 24; at Guanajay and Mariel, April 27 to May 15, and at Cabañas May 15 to June 4. The locality El Guamá has become very important as the type-locality of the as yet unique *Bufo longinasus*. Mr. Palmer describes it as a small store situated in a pleasant valley in the coffee and tobacco belt, surrounded by precipitous hills, those to the north being covered with pines. Between these hills the stony beds of mountain streams, nearly dry except for scattered pools of water at the time of his visit, made their way toward the south. In one of these rocky beds near the pine woods the precious type of that minute toad was captured.

About the same time Dr. C. W. Richmond and myself who had spent several months collecting in Porto Rico, stopped on our return a few days (Apr. 22 to 24, 1900), at Santiago de Cuba. The visit was unexpected and all our collecting paraphernalia were packed away. Dr. H. B. Parker, the resident port surgeon, very kindly supplied us with some formalin, so that we were able to preserve a number of specimens which we collected in one of the valleys close to town. I made very careful color notes on the fresh specimens, which are incorporated verbatim in the present report.

Mr. B. S. Bowdish, of Demarest, New Jersey, was employed by the United States National Museum for a short time in the latter part of 1901 and the beginning of 1902. He collected in the eastern part of the island, principally at Guamá and in the immediate vicinity of

Santiago de Cuba. Guamá is a mining camp near the coast, about 40 miles due west from Santiago de Cuba. He describes the region as a very wild one, with no habitations in the immediate vicinity save those connected with the camp. The mines are some 5 miles back from the coast on precipitous hills and the camp was situated just below them.

Mr. William Palmer in the latter half of January and the first half of February, 1902, again visited Cuba, this time the eastern end. The reptiles collected were obtained mostly at Baracoa and at San Luis and El Cobre, not far from Santiago de Cuba.



FIGS. 1–2.—BUFO PELTOCEPHALUS. NAT. SIZE. NO. 28024, U.S.N.M NUEVA GERONA, ISLE OF PINES.

While stationed at Matanzas in 1899 Mr. J. W. Daniel, jr., made a small collection of reptiles, which he afterwards presented to the United States National Museum. While not extensive, it was nevertheless a very interesting lot, since it contained species not obtained by any of the other parties and heretofore represented in the Museum by unsatisfactory material only or not at all.

I have to thank Dr. Thomas Barbour for examining and verifying the identification of the various species of *Anolis* and *Eleutherodactylus*, of which he has made a special study, as well as for data relating to the specimens of *Arrhyton* in the Museum of Comparative Zoölogy. His various writings on West Indian batrachians and reptiles, particularly his Contribution to the Zoogeography of the West Indies, with especial reference to Amphibians and Reptiles[1] and The Reptiles and Amphibians of the Isle of Pines[2] have been of the utmost assistance.

[1] Mem. Mus. Comp. Zoöl., vol. 44, No. 2, 1914. [2] Ann. Carnegie Mus., vol. 10, pp. 297–308.

AMPHIBIA.

SALIENTIA.

BUFO LONGINASUS Stejneger.

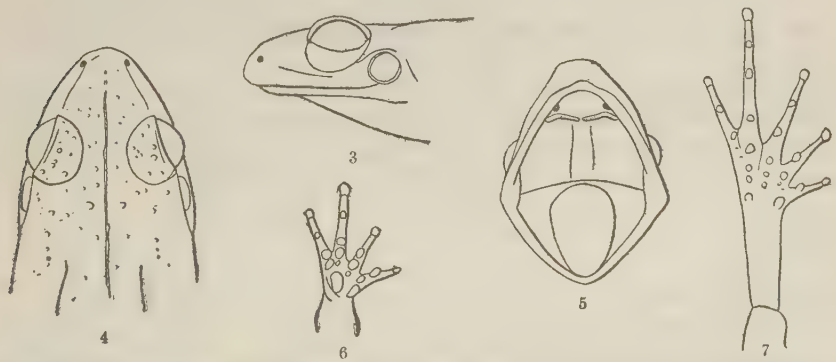
This diminutive and beautiful toad was the most important discovery of the Palmer and Riley expedition. A single specimen was captured by Mr. Palmer at dusk on March 9, 1900. It was sitting on a rock in a mountain stream near El Guamá, Pinar del Rio, and no other specimen was seen. Doctor Barbour, who searched for it at the same place some years later without rediscovering it, has suggested that its habits, as indicated by the extensively webbed hind feet, may be quite aquatic, which may account for it being so difficult to find. It was described in the Proceedings of the United States National Museum.[1]

BUFO PELTOCEPHALUS Tschudi.

Figs. 1 to 2.

Judging from the number brought home by Palmer and Riley, this large toad must be quite common. Numerous specimens were collected in July at Nueva Gerona, Isle of Pines, and others at El Guamá, Pinar del Rio, in March, and at Guanajay in May. Palmer, in 1902, sent in additional specimens from El Cobre, captured in February.

Two views are given of the head of a specimen from the Isle of Pines. I can discover no difference between the toads from this island and the main island of Cuba.



FIGS. 3–7.—ELEUTHERODACTYLUS RICORDII. 3 × NAT. SIZE. NO. 27415, U.S.N.M. PINAR DEL RIO.

ELEUTHERODACTYLUS RICORDII Duméril and Bibron.

Figs. 3 to 7.

Only two specimens were secured—one adult, No. 27414, from El Guamá, and a younger one, No. 27415, from Pinar del Rio, both in March, 1900.

Although differing somewhat, the two specimens apparently belong to the same species.

[1] Vol. 28, June 24, 1915, p. 765, figs. 1–6

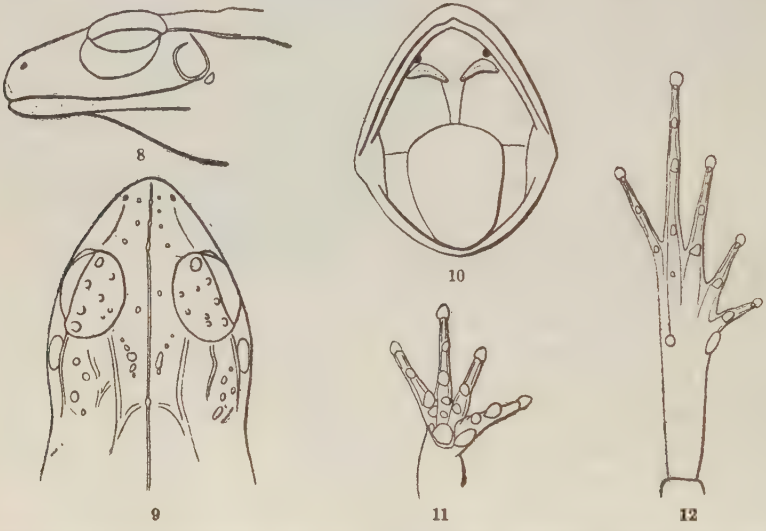
ELEUTHERODACTYLUS AURICULATUS (Cope).

Three specimens from San Diego de los Baños, by Palmer and Riley, and one from Baracoa. The former thus confirm the occurrence of this species in western Cuba. The type came from eastern Cuba.

ELEUTHERODACTYLUS CUNEATUS (Cope).

Figs. 8 to 12.

A large number of specimens were collected in 1900 at El Guamá and at San Diego de los Baños in March and April. Adult and young



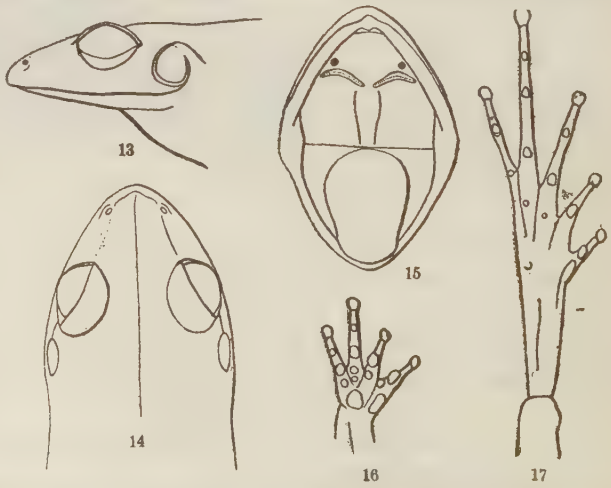
FIGS. 8–12.—ELEUTHERODACTYLUS CUNEATUS. 2 × NAT. SIZE. NO. 26654, U.S.N.M. SAN DIEGO DE LOS BAÑOS.

were also taken by Palmer at Baracoa in January, 1902. They have been compared with the cotypes in the Museum (U.S.N.M. No. 5202) which were collected in eastern Cuba by Dr. C. Wright.

ELEUTHERODACTYLUS DIMIDIATUS (Cope).

Figs. 13 to 17.

The species is recorded here, as Mr. Bowdish, in December, 1901, obtained a specimen at Guamá, No. 29767.

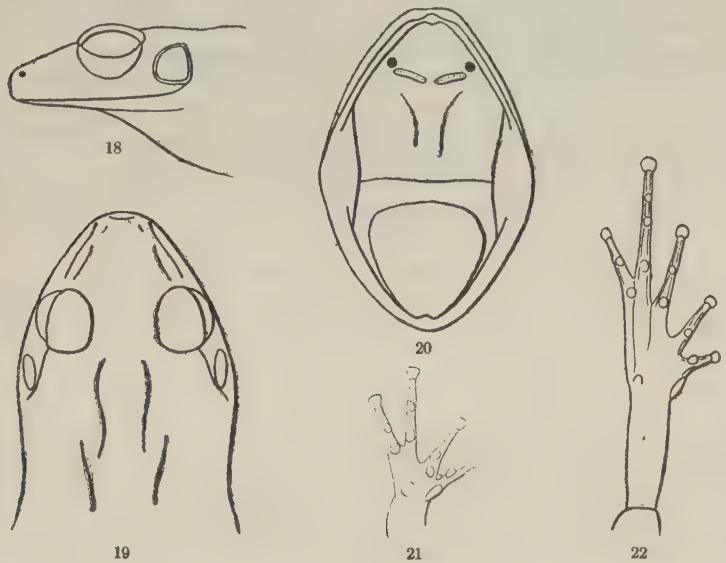


FIGS. 13–17.—ELEUTHERODACTYLUS DIMIDIATUS. 2 × NAT. SIZE. NO. 29767, U.S.N.M. GUAMÁ, EASTERN CUBA.

ELEUTHERODACTYLUS VARIANS (Gundlach and Peters).

Figs. 18 to 22.

Five specimens from El Guamá, San Diego de los Baños, and Mariel, were collected by Palmer and Riley.

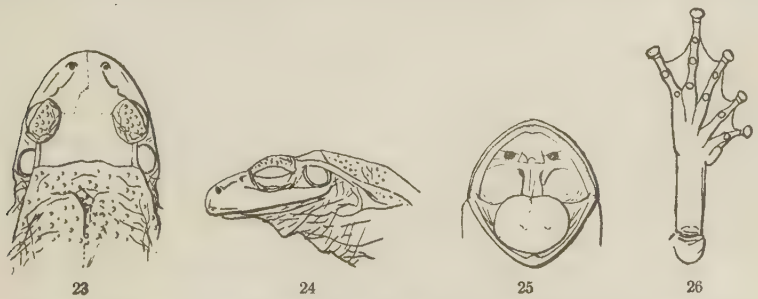


FIGS. 18–22.—ELEUTHERODACTYLUS VARIANS. 3 × NAT. SIZE. NO. 27417, U.S.N.M. EL GUAMÁ, PINAR DEL RIO.

HYLA SEPTENTRIONALIS Boulenger.

Figs. 23 to 26.

Of this common species Palmer and Riley brought home a large number of specimens from most of the localities visited, Habana,



FIGS. 23–26.—HYLA SEPTENTRIONALIS. ⅔ × NAT. SIZE. NO. 27425, U.S.N.M. PINAR DEL RIO.

Pinar del Rio, San Diego de los Baños, Guanajay, Cabañas, Marianao, as well as from the Isle of Pines.

Doctor Richmond and myself found it at Santiago de Cuba on April 22, 1900. A specimen (No. 26794 U.S.N.M., collector's No. 9073) was caught, regarding which I made the following notes at the time: Iris brassy; a dark grayish line from nostrils through eye (pupil) to over and behind tympanum. When caught, the whole animal was nearly uniform whitish, although sitting on a green leaf; when taken out of the bag in which it was brought to the laboratory it was very pale drab above with faint indications of dusky markings on the back and limbs.

REPTILIA.

SAURIA.

GONATODES FUSCUS (Hallowell).

It is with but slight hesitation that I record the Cuban gecko of this genus under the above name,[1] and I can not accept *Gonatodes albogularis* at the present time as the correct name. *Gonatodes albogularis* was based upon specimens from Martinique,[2] and although they were said to have been collected by Plée, there appears to be no reason to doubt the authenticity of the locality, since no such gecko occurs in Porto Rico. But if the types came from Martinique, the chances are that they agree more nearly with one of the South American forms, especially as Boulenger has recorded *Gonatodes vittatus* from the Island of Dominica. If this surmise is correct, the Cuban gecko must take the name of the Central American form. It is true that the name *Gymnodactylus maculatus* [3] has been applied to specimens doubtfully alleged to have come from Cuba, but I have had the good fortune to examine the type-specimen in the Museum in Vienna and found it to agree exactly with specimens from Carácas, and I have no hesitation in asserting that the Cuban locality is erroneous; it is probably a female *G. vittatus*.

I have also been able to examine the type of *Gonatodes notatus* [4] in the Museum at Copenhagen. It is registered as No. 18, and was collected by Lieut. H. Koch at Acquin, Haiti. For comparison I had specimen No. 14, collected in Cuba by Captain Andrea and recorded by Reinhardt as *Gonatodes albogularis*. The difference

[1] *Stenodactylus fuscus* Hallowell, Journ. Acad. Nat. Sci. Philadelphia (n. s.), vol. 3, 1855, p. 33 (type-locality, Nicaragua).

[2] *Gymnodactylus albogularis* Duméril and Bibron, Erp. Gén., vol. 3, 1835, p. 415 (type-locality, Martinique); Duméril, Cat. Méth Rept. Mus. Paris, vol. 1, 1851, p. 43.

[3] Steindachner, *Novara* Exp., Zool., vol. 1, Rept., 1867, p. 18, pl. 1, fig. 4 (type-locality unknown).

[4] *Gonatodes notatus* Reinhardt and Lütken, Vid. Medd. Naturh. For. (Copenhagen) 1863 (p. 280); separate, p. 128 (type-locality, Acquin, Haiti).

between the two is not one of coloration only, but the Haitian specimen has decidedly larger scales than the Cuban. This observation I also had occasion to verify in the Museum at Vienna on two specimens from Gonaives, Haiti, so that I have no doubt that the name *Gonatodes notatus* can not be applied to the Cuban form. These Haitian specimens, moreover, had the lateral black band of *G. albogularis*. The Cuban form consequently differs both from *notatus* and from true *albogularis* and *vittatus* in the smaller abdominal and subfemoral scales. The coloration appears also quite characteristic, especially that of the old males. I have before me a color sketch by Mr. J. H. Riley, made in 1900 from a living specimen taken in Habana. The male is of a bluish black with head and neck of bright ochraceous yellow. There is a distinct sky-blue narrow line on the labials under the eye, a small spot of the same color above the ear, and a crimson spot on the side of the neck on the yellow where it joins the black body-color. Unfortunately the bright colors of the living animal fade in alcohol, and I know of no good color description of of typical *Gonatodes fuscus* taken from living specimens, but we have specimens from Nicaragua in alcohol, for instance, No. 19646, a male collected by Dr. C. W. Richmond at Greytown, Nicaragua, on February 12, 1892, which both in color and scutellation exactly match Mr. Riley's Habana specimens as they now appear in alcohol.

I can not throw much light on the question of the identity of *G. albogularis* and *G. vittatus*. The United States National Museum has numerous specimens from Curaçao which, from the large subfemoral scales and the characteristic coloration, I have no hesitation in identifying as *G. albogularis;* that is, the males have the broad dark blue band on the side of the neck, uniform grayish back and white throat. There are also two typical *G. vittatus* from Venezuela.[1] I am unable to appreciate any marked difference in scutellation or proportions, but the coloration is certainly very different in both sexes. What puzzles me is that Boulenger refers a male from Curaçao to *G. vittatus*.[2] He afterwards expressed the opinion that *G. vittatus* is only a "variety" of *G. albogularis*.

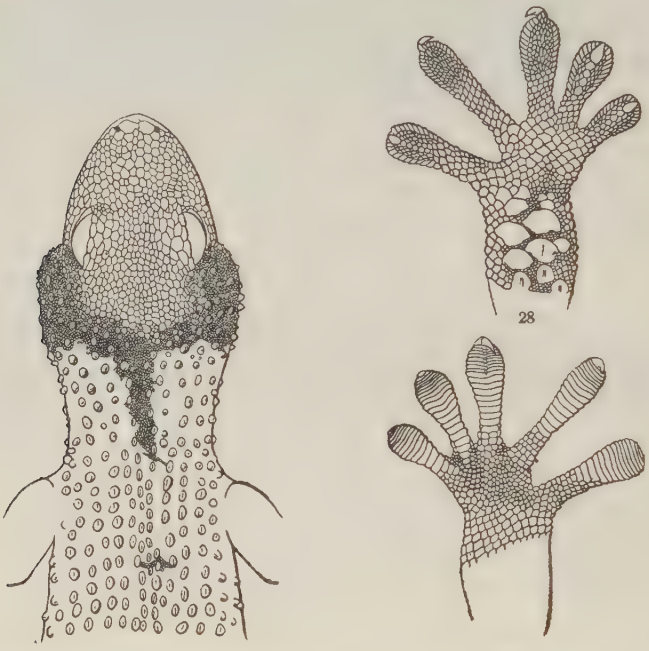
Barbour, in his Contribution to the Zoogeography of the West Indies (p. 256), hints at the possibility of this species having been introduced fortuitously into Cuba. It is true that most specimens recorded have been from Habana and Santiago, but Barbour mentions a couple of occurrences from other localities, and Palmer and Riley collected four specimens at Mariel.

[1] Stejneger, Proc. U. S. Nat. Mus., vol. 24, 1901, p. 181.
[2] Cat. Liz. Brit. Mus., vol. 1, 1885, p. 60.

TARENTOLA CUBANA Gundlach and Peters.

Figs. 27 to 29.

A single specimen of this rare species was taken by Bowdish at Guamá, on January 6, 1902. Unfortunately it was very much damaged (No. 29777 U.S.N.M.).



FIGS. 27–29.—TARENTOLA CUBANA. 2 × NAT. SIZE. No. 29777, U.S.N.M. GUAMÁ, EASTERN CUBA.

SPHAERODACTYLUS ELEGANS MacLeay.

In 1834 MacLeay named a Cuban gecko *Sphaeriodactylus elegans*.[1] It was revived for the present species by Reinhardt and Lütken in 1863.

Palmer and Riley collected this species at Pinar del Rio, February 23, at Mariel, June 10, and in Habana July 28, 1900. They also obtained a specimen at Nueva Gerona, on the Isle of Pines, on July 11.

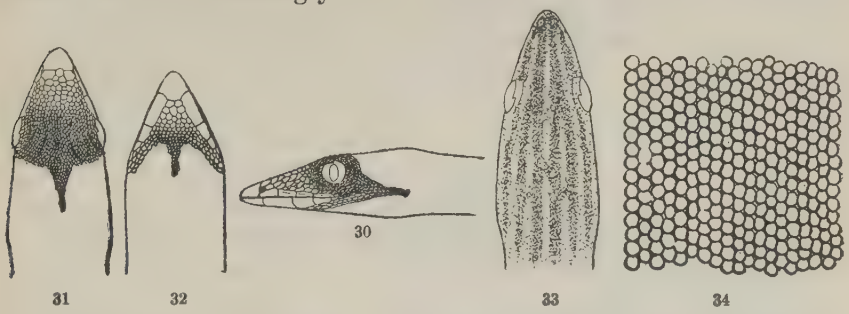
SPHAERODACTYLUS CINEREUS MacLeay.

Figs. 30 to 34.

This species was also first briefly characterized by Mr. MacLeay[1] as *Sphaeriodactylus cinereus* from Cuban specimens without more definite locality. Cocteau's employment of the name did not take place until late in 1837, probably in December, when it appeared in the second "livraison" of de la Sagra's Histoire Physique, Politique

[1] Proc. Zool. Soc. London, 1834, p. 12; Trans. Zool. Soc. London, vol. 1, p. 193.

et Naturelle de l'Ile de Cuba on plate 18. The text was not published until the following year.



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FIGS. 30–33.—SPHAERODACTYLUS CINEREUS. 2¾ × NAT. SIZE. NO. 27390, U.S.N.M. PINAR DEL RIO.—34, 8 × NAT. SIZE. LEPIDOSIS OF MIDDLE OF BACK. SAME SPECIMEN.

Numerous specimens were collected by Palmer and Riley in various localities, namely, at Pinar del Rio, Mariel, and Habana.

SPHAERODACTYLUS NOTATUS Baird.

Palmer and Riley did not obtain this species, but Bowdish collected one at Guamá on January 2, 1902.

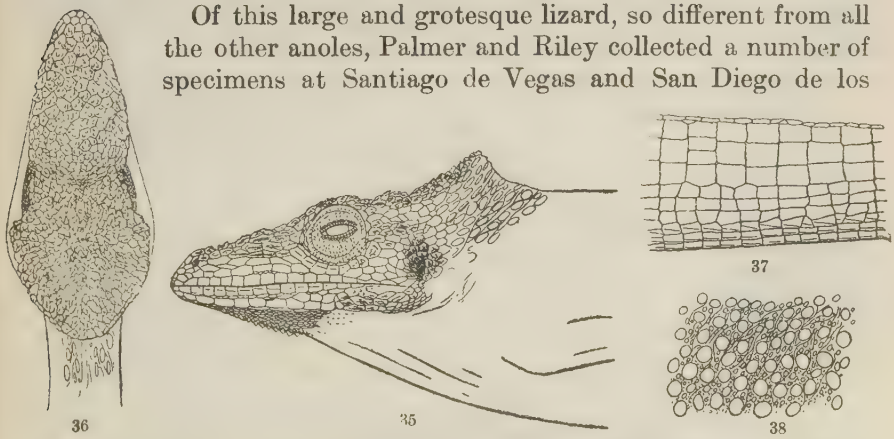
HEMIDACTYLUS MABOUIA (Moreau de Jonnès).

Two specimens were collected by Palmer and Riley on May 9, 1900, at Mariel. One of these specimens has been described in detail and figured in my Herpetology of Porto Rico.[1] According to Cocteau this species is widely distributed in Cuba.

CHAMAELEOLIS CHAMAELEONIDES (Duméril and Bibron).

Figs. 35 to 38.

Of this large and grotesque lizard, so different from all the other anoles, Palmer and Riley collected a number of specimens at Santiago de Vegas and San Diego de los



36 35 37 38

FIGS. 35–36.—CHAMAELEOLIS CHAMAELEONIDES. ⅔ × NAT. SIZE. NO. 27502, U.S.N.M. SAN DIEGO DE LOS BAÑOS.—37 REPRESENTS THE SIDE OF THE TAIL AT ABOUT THE FIFTH VERTICIL, 1½ × NAT. SIZE; 38, THE LEPIDOSIS OF THE SIDE OF BACK, ⅔ × NAT. SIZE.

Baños. Palmer collected another specimen at Baracoa in 1902. Recently the United States National Museum has received specimens

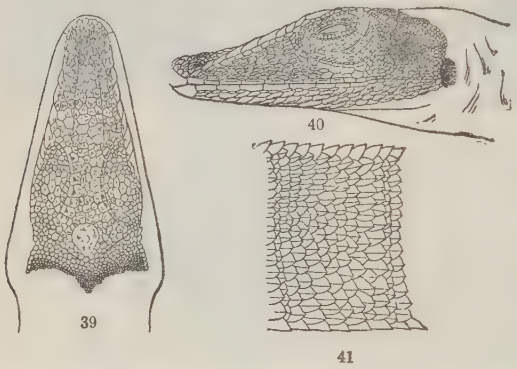
[1] Rep. U. S. Nat. Mus., 1902 (1904), p. 599, figs. 40–44.

collected by Dr. Paul Bartsch and Mr. J. B. Henderson at Cabañas, La Mulata, and Cape San Antonio.

DEIROPTYX VERMICULATA (Duméril and Bibron).

Figs. 39 to 41.

This large anolis is so isolated and unrelated not only to the other species in Cuba, but to all known species of the whole anoline subfamily, that its recognition as a separate generic type is justly called for. The most obvious structural character which is unique in the group is the absence of a dewlap and the presence of a transverse throat fold.



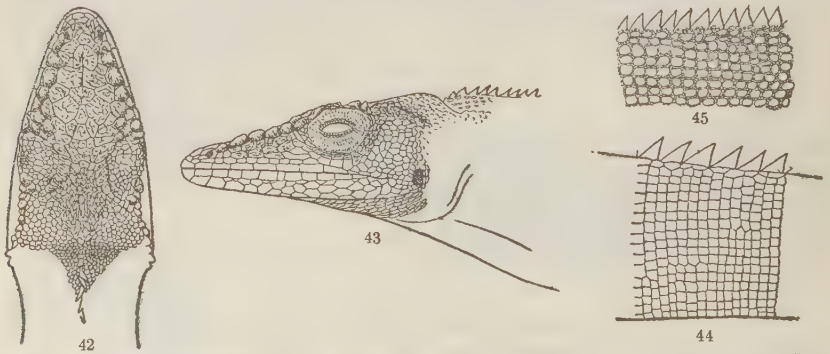
FIGS. 39–40.—DEIROPTERYX VERMICULATA. NAT. SIZE. NO. 27335, U.S.N.M. EL GUAMÁ, PINAR DEL RIO.—41. SIDE OF TAIL OF SAME AT ABOUT THE FIFTH VERTICIL. 2½ × NAT. SIZE.

Palmer and Riley, who collected numerous specimens at San Diego de los Baños and at El Guamá, Pinar del Rio, corroborate Doctor Gundlach's observation that this species takes to the water when pursued or wounded.

ANOLIS EQUESTRIS Merrem.

Figs. 42 to 45.

Four adult specimens were collected by Palmer and Riley at El Guamá, Pinar del Rio, at San Diego de los Baños, and at Guanajay. Bowdish obtained one at Guamá the following year.



FIGS. 42–43.—ANOLIS EQUESTRIS. ⅔ × NAT. SIZE. NO. 27504, U.S.N.M. SAN DIEGO DE LOS BAÑOS.—44 REPRESENTS SIDE OF TAIL AT ABOUT THE FIFTH VERTICIL.—45, PART OF DORSAL CREST AND LEPIDOSIS 1½ NAT. SIZE; SAME INDIVIDUAL.

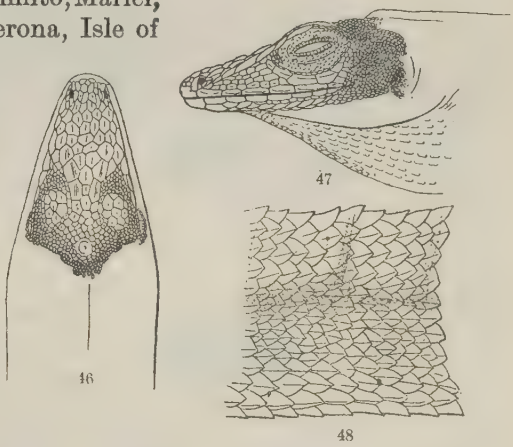
ANOLIS HOMOLECHIS (Cope).

Figs. 46 to 48.

This species was originally described by Cope as *Xiphosurus homolechis*,[1] from a specimen in British Museum, the habitat of which was

[1] Proc. Acad. Nat. Hist., Philadelphia, 1864, p. 169.

unknown beyond the fact that it was from some island in the West Indies. When Boulenger, in 1885, published the second volume of his Catalogue of Lizards the specimen was still unique and the particular island to which it belongs unknown. However, in 1892 Müller, of Basel, recorded it from Cuba,[1] and since then it has been found there by nearly all collectors; thus, by Doctor Richmond and myself in 1900 at Santiago de Cuba, in eastern Cuba, and by Palmer and Riley in the western part. They brought home numerous specimens from San Diego de los Baños, where it must have been very common, and also from El Guamá, Caimito, Mariel, as well as from Nuevo Gerona, Isle of Pines. It is quite remarkable that this rather conspicuous species escaped the attention of Doctor Gundlach.



FIGS. 46–47.—ANOLIS HOMOLECHIS. 2 × NAT. SIZE. NO. 26770, U.S.N.M. SANTIAGO DE CUBA.—48 REPRESENTS SIDE OF TAIL AT ABOUT THE FIFTH VERTICIL, 4 × NAT. SIZE, OF SAME INDIVIDUAL.

At Santiago de Cuba on April 23, 1900, I took the following color notes from a specimen collected by Doctor Richmond (No. 26770 U.S.N.M., collector's No. 9074): Iris blackish-brown; edge of eyelids bright yellow; general color above isabella colored with a wash of cinnamon, especially on the flanks; a series of faintly indicated narrow dusky chevron marks with the points turned backward on the median line of the back; on sacrum a larger, irregular, dusky mark on each side; on the sides of back and flanks numerous vertical rows of small pale dots more or less margined with dusky; a faint narrow pale line from above shoulder to insertion of hind limb; suboculars whitish; tail with the merest indication of dusky crossbars; throat and foreneck white, the sides of throat with several series of darkish gray spots; rest of underside delicate straw-yellow, gradually merging into the white of the foreneck and the cinnamon of the flanks; underside of limbs with minute gray dots; a line composed of blackish dots along posterior edge of forelimb and outer edge of tibia; a series of yellow dusky-margined ocelli on posterior edge of femur; dewlap pale pearl-gray with distant white scales and slightly thickened anterior edge of white scales; tongue flesh colored; a low but long nuchal fold and a low dorsal fold; on the tail a pretty high crest of the *A. cristatellus* order, but the end of the tail seems to be prehensile to

[1] Verh. Naturf. Ges. Basel, vol. 10, pt. 1, p. 211.

some extent, inasmuch as the specimen which was held captive for a little while occasionally rolled the tip of the tail up under him much after the fashion of a true chameleon. The specimen before it was caught was of a nearly uniform rich dark brown.

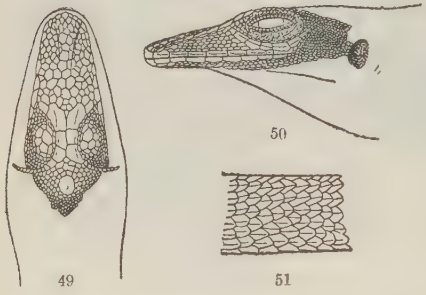
ANOLIS LUCIUS Duméril and Bibron.

Three specimens were collected by Palmer and Riley at Matanzas on February 14, 1900.

ANOLIS ARGENTEOLUS Cope.

Figs. 49 to 51.

Four specimens collected by myself on April 22, 1914, near Santiago in the eastern part of the island, shortly after Mr. Palmer obtained the Matanzas specimens of *A. lucius*, afforded a chance for direct comparison of these two species which Boulenger had united.[1] The differences are many and the separation fully justified, as already set forth by Doctor Barbour.[2]



FIGS. 49–50.—ANOLIS ARGENTEOLUS. 2 × NAT. SIZE. NO. 26777, U.S.N.M. SANTIAGO DE CUBA.—51 REPRESENTS THE LEPIDOSIS OF THE SIDE OF TAIL AT ABOUT THE FIFTH VERTICIL, 4 × NAT. SIZE, FROM SAME INDIVIDUAL.

A specimen (No. 26777 U.S. N.M., collector's No. 9071) collected by myself was colored as follows: Ground color above pale ecru-drab with faint dusky markings and a series of white spots, ill defined but more or less margined with dusky down the median line of the back; tail cross-banded with pale dusky; supralabials and subocular white; underside white, waxy, almost translucent, the throat with narrow gray divergent lines which disappear on the neck; dewlap whitish with series of rather close-set white scales; tongue white. Several smaller individuals, with scarcely a dewlap, resemble the specimen described, but the whole belly is decidedly primrose-yellow, not white as the rest of the under surface. Found principally on trunks of trees with pale-colored bark.

Additional specimens were collected by Palmer in 1902 at El Cobre and San Luis.

ANOLIS SAGREI Duméril and Bibron.

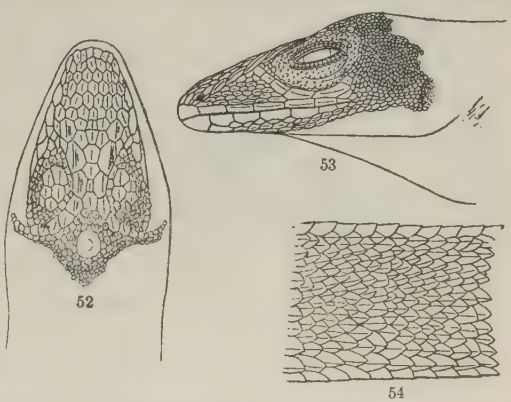
Figs. 52 to 54.

Large series of this common species were secured by all the parties. A mere enumeration of the localities will be sufficient: San Diego de los Baños; Santiago de Cuba; El Guamá, Pinar del Rio; Quemadas; Matanzas; Pinar del Rio; Guanajay; Caimito; Mariel; Cabañas; Habana; San Luis; El Cobre; and Nuevo Gerona on the Isle of Pines.

[1] Cat. Liz. Brit. Mus., vol. 2, 1885, p. 45.

[2] Mem. Mus. Comp. Zoöl., vol. 44, No. 2, March, 1914, p. 285.

The following color note on the living specimen was taken by me at Santiago de Cuba April 22, 1900 (No. 26771, U.S.N.M., collector's No. 9072): Ground color above drab more or less washed with rusty, with indication of cinnamon colored median dorsal band and dusky cross markings on either side; tail closely cross-barred with dusky; underside whitish with pale indications of gray stripes on side of neck; dewlap intense scarlet vermillion, the anterior edge thickened with scales which, like the distant scales on the pouch, are straw-yellow; on back and neck erectile folds as in *Anolis cristatellus*. This species varies greatly in color, the ground being often either much grayer or browner than in the individual described, and the markings darker and more distinct. In many individuals the median dorsal cinnamon band is also brighter and more distinctly defined.



FIGS. 52-53.—ANOLIS SAGREI. 2⅔ × NAT. SIZE. NO. 26771, U.S.N.M. SANTIAGO DE CUBA.—54 REPRESENTS SIDE OF TAIL AT ABOUT THE FIFTH VERTICIL, FROM SAME INDIVIDUAL. 5⅓ × NAT. SIZE.

Anolis sagrei is found on the ground and on fence posts, and is much more wary and shy than the other two species, *porcatus* and *homolechis*. With its erectile crests and color, it reminds one of *A. cristatellus*, but it is much shyer.

ANOLIS LOYSIANA (Cocteau).

The original description of this species is usually quoted as occurring in Compte Rendu des Séances de l'Academie des Sciences (Paris)[1], but as a matter of fact the name does not occur there. It is found, however, in L'Institut,[2] where the species is properly diagnosed and named *Acantholis loysiana*. Cocteau's paper, of which only an abstract is printed, was presented at the meeting of the Royal Academy two days before.

A number of specimens of this peculiar species were collected by Palmer and Riley at San Diego de los Baños April 16 and 17, 1900.

ANOLIS ALUTACEUS Cope.

On the main island only taken at San Diego de los Baños by Palmer and Riley in April. Two others were also collected by them at Nueva Gerona, Isle of Pines, as previously recorded by Barbour.

[1] Vol. 3, 1836, p. 226.
[2] Sec. 1, vol. 4, Aug. 31, 1836, p. 287.
[3] Ann. Carnegie Mus., vol. 10, 1916, p. 302.

ANOLIS ANGUSTICEPS Hallowell.

Specimens of this interesting species, the proper name of which has only recently been available, thanks to Doctor Barbour's researches, were collected by Palmer and Riley at Nueva Gerona, Isle of Pines, on June 5, 1900.

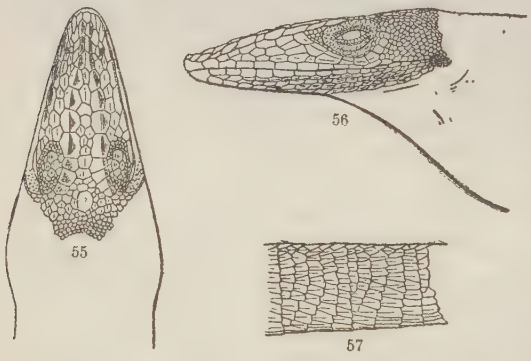
ANOLIS MESTREI Barbour.

Of this recently described species [1] Palmer and Riley collected four specimens—three at San Diego de los Baños and one at El Guamá near Pinar del Rio, the latter according to Mr. Palmer's notes, near top of mountain.

ANOLIS PORCATUS Gray.

Figs. 55 to 57.

A common species. The large series collected at San Diego de los Baños helped to confirm its specific distinctness from *A. carolinensis* of the southern United States. Palmer and Riley collected it also at Pinar del Rio, Guanajay, Caimito, Cabañas, and Habana, as well as on the Isle of Pines. Dr. C. W. Richmond and I met with it at Santiago de Cuba, and Mr. Bowdish collected it there and at Guamá.



FIGS. 55–56.—ANOLIS PORCATUS. 1⅛ × NAT. SIZE. No. 26776, U.S.N.M. SANTIAGO DE CUBA.—57 REPRESENTS SIDE OF TAIL AT ABOUT FIFTH VERTICIL OF SAME INDIVIDUAL, 2⅔ × NAT. SIZE.

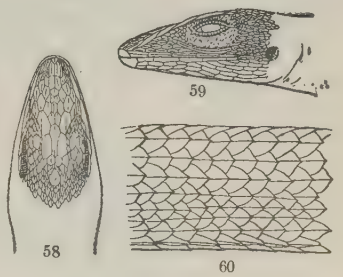
Among my notes taken at the time I find the following color description of the specimen collected (No. 26776, U.S.N.M., collector's No. 9069): Above brilliant emerald green changing almost to raw sienna when shot; underside white washed with "pale blue", underside of tail with greenish; dewlap light purple with distinct white scales (no black postocular or transauricular patch). A somewhat smaller individual at the same time had the dewlap of the same color and also the same general green body color, but down the middle of the back it had a well-marked, narrowly dusky-edged clay-colored band.

[1] Proc. Biol. Soc. Washington, vol. 29, Jan. 25, 1916, p. 19.

NOROPS OPHIOLEPIS (Cope).

Figs. 58 to 60.

A good series was obtained by Palmer and Riley at San Diego de los Baños and Pinar del Rio.



FIGS. 58–59.—NOROPS OPHIOLEPIS. 2 × NAT. SIZE. NO. 27367, U.S.N.M. PINAR DEL RIO.—60 REPRESENTS SIDE OF TAIL, AT ABOUT THE FIFTH VERTICIL, OF SAME INDIVIDUAL. 4 × NAT. SIZE.

CYCLURA CYCLURA (Cuvier).

Palmer and Riley were very fortunate in obtaining several fine adults of this species on the Isle of Pines.

LEIOCEPHALUS CARINATUS Gray.

Figs. 61 to 62.

This species was collected by Bowdish and by myself at Santiago de Cuba and by Palmer and Riley at Mariel, Cabañas, and Marianao as well as on the Isle of Pines at Nueva Gerona.

The colors of a freshly killed specimen at Santiago de Cuba (No. 26767 U.S.N.M., collector's No. 9077) are as follows: Above dark brownish gray with narrow irregular bands of isabella color; head uniform dark; tail cross-barred; underside whitish with oblique gray bands on throat and indistinct gray cross bands on belly to groin; a black blotch behind eye and two oblique blackish bands on side of neck.

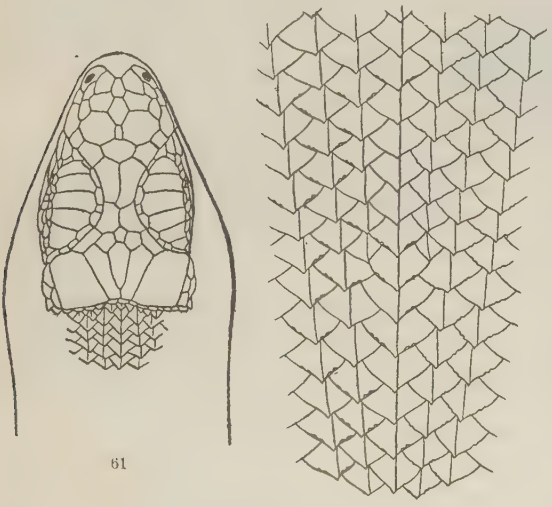


FIG. 61.—LEIOCEPHALUS CARINATUS. 2 × NAT. SIZE. NO. 26768, U.S.N.M. SANTIAGO DE CUBA.—62 REPRESENTS A HEAD LENGTH OF SCALES ON THE MIDDLE OF BACK OF THE SAME INDIVIDUAL. 4 × NAT. SIZE.

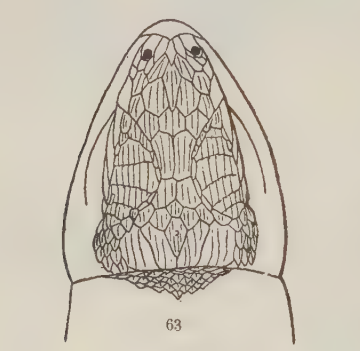
LEIOCEPHALUS CUBENSIS (Gray).

Figs. 63 to 65.

The name *L. vittatus* (Hallowell, 1856) by which this species is generally known is 16 years younger than *Tropidurus* (*Leiolaemus*) *cubensis* Gray,[1] given to a male specimen collected by W. S. MacLeay in Cuba.

[1] Ann. Nat. Hist., vol. 5, Apr. 1840, p. 110.

Boulenger[1] makes *Leiocephalus raviceps* Cope a synonym of this species. I have the types of Cope's species (No. 4162 U.S.N.M.) collected by Charles Wright in "Eastern Cuba" before me and can affirm that *L. raviceps* is a very distinct species and that the two have absolutely nothing to do with each other. In fact, they belong to different sections of the genus. Thus *L. cubensis* has three pairs of prefrontals (exclusive of internasals) while *L. raviceps* has only



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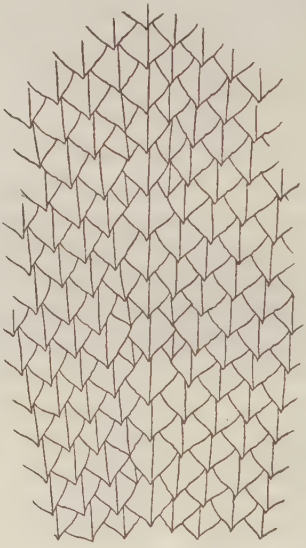

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FIGS. 63-64.—LEIOCEPHALUS CUBENSIS. 2 × NAT. SIZE. NO. 27375, U.S.N.M. PINAR DEL RIO.—65. REPRESENTS A HEAD LENGTH OF SCALES ON THE MIDDLE OF BACK OF THE SAME INDIVIDUAL. 4 × NAT SIZE.

two, the posterior pair being exceedingly large. Moreover, *L raviceps* is distinguished by much smaller scales, about 20 corresponding to a head length against about 12 in *L. cubensis*. It is related to *L. loxogrammus*, but not to *L. cubensis*.

The latter is widely distributed and was collected by Palmer and Riley at San Diego de los Baños, at Pinar del Rio, El Guamá, Caimito, Marianao, and on the Isle of Pines at Nueva Gerona. Also by Palmer in 1902 at Moro.

LEIOCEPHALUS MACROPUS Cope.

Figs. 66 to 67.

According to the old label in the bottle containing the types of this species in the United States National Museum, they came from Monte Verde in Eastern Cuba. The species seems to be confined to that portion of the island, as it was not collected by Palmer and

[1] Cat. Liz. Brit. Mus., vol. 2, 1885, p. 163.

Riley. It was found by Doctor Richmond and myself at Santiago de Cuba in 1900, and Palmer, in 1902, collected it at San Luis and Baracoa.

The colors of a specimen collected at Santiago de Cuba (No. 26769, U.S.N.M., collector's No. 9078) are as follows: Upper side vinaceus cinnamon with a coppery gloss; head more cinnamon; tail with blackish cross-bars narrowly edged with white posteriorly; from nostrils through eye along sides of neck and body to above and behind insertion of hind leg a broad blackish-brown band narrowly edged with pale above and below; upper labials, suboculars, and lower temporals to ear white; below whitish; throat and fore neck with numerous gray dots; lower labials dusky.

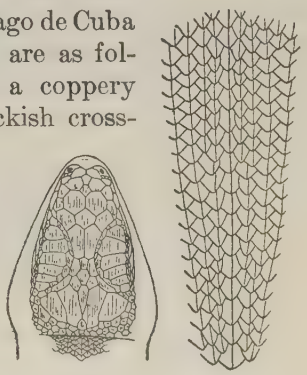
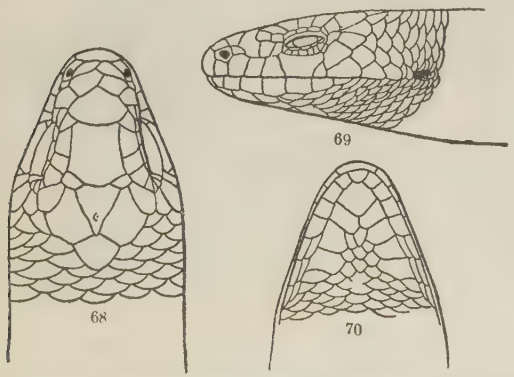


FIG. 66.—LEIOCEPHALUS MACROPUS. 2 × NAT. SIZE. NO. 26769, U.S.N.M. SANTIAGO DE CUBA.—67 REPRESENTS A HEAD LENGTH OF SCALES ON MIDDLE OF BACK OF SAME INDIVIDUAL, 4 × NAT. SIZE.

CELESTUS DE LA SAGRA (Cocteau).

Figs. 68 to 70.

The portion of de la Sagra's great work on Cuba, which treated of the lizards was published before the end of the year 1838. On the other hand, the fifth volume of Duméril and Bibron's Erpétologie Générale did not appear until late in 1839 (the "Avertissement" is dated Oct. 1, 1839), and Cocteau's name for this species has a year's priority over their emendation of it.



FIGS. 68–70.—CELESTUS DE LA SAGRA. 2 × NAT. SIZE. NO. 27647, U.S.N.M. CABAÑAS.

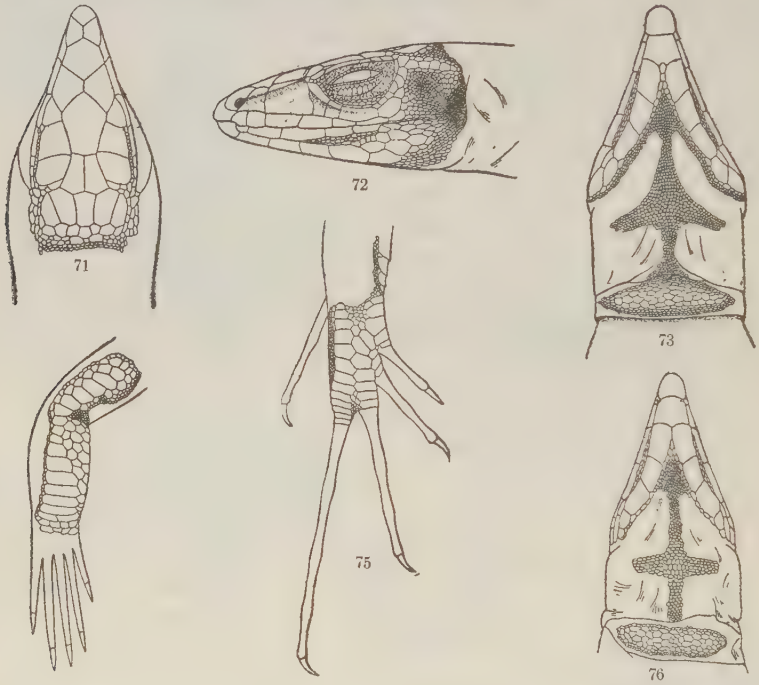
Only one specimen of this slippery species was brought home by Palmer and Riley. It was taken at Cabañas, on May 15, 1900. The museum, about the same time obtained a specimen from Mr. J. W. Daniel, jr., collected at Matanzas.

AMEIVA AUBERI Cocteau.

Figs. 71 to 76.

This species is usually described as having the gular scales uniform and minutely granular. This is also the condition in a large number

of specimens. However, in most of them there is a tendency to a slight enlargement of the median granules and in quite a few there is a well-pronounced median patch, as shown, for instance, in No. 27370 (fig. 76). This feature in several of our specimens, coupled with the difference in the relation of the first pair of chin-shields as shown in figures 73 and 76, and certain color differences which I



FIGS. 71–75.—AMEIVA AUBERI. 2 × NAT. SIZE. NO. 26765, U.S.N.M. SANTIAGO DE CUBA.—76 THROAT OF ANOTHER SPECIMEN, 1½ × NAT. SIZE. NO. 27370; EL GUAMÁ, PINAR DEL RIO.

noted, at one time induced me to believe that there might be two species of Ameiva in Cuba. Upon closer examination, however, it appears that no line can be drawn and that we have to do with a considerable degree of individual variation only.

Specimens collected by myself at Santiago de Cuba, April 23, 1900, were much more brilliantly colored than Cocteau's plate 6.[1] A male (No. 26765 U.S.N.M., collector's No. 9075) had top of head and a broad stripe on each side of the middle of the back tawny olive, the limbs above of the same color with blackish-brown marblings; from the interparietal to the base of the tail on the median line of the back a strongly defined whitish line which is slightly washed with greenish anteriorly and bluish on the sacrum, where it is gradually

[1] Hist. Fis. Pol. Nat. Cuba, vol. 4.

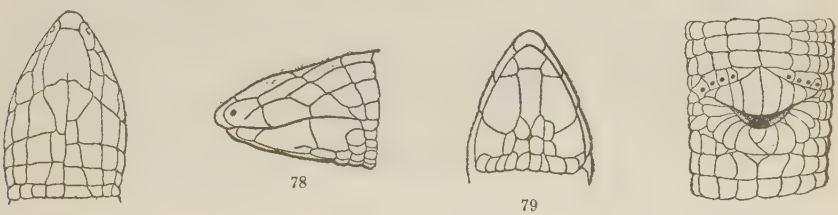
widening; on each side of the tawny olive dorsal band a narrow clay-colored line beginning at the posterior superciliaries and ending above insertion of hind legs; a similar line beginning at the posterior corner of eye over upper edge of ear to hind limb; between these lines a broad brownish-black band, which, however, is tawney olive like the dorsal band in front of the anterior legs; flanks above pale tawny olive dappled with pale dots, below colored like the underside and similarly dotted; tip of snout, chin and labials pale Indian red, underside whitish, belly strongly washed with turquoise blue becoming darker on tail toward the end; throat and foreneck inky black; tail clear turquoise blue in continuation of the median dorsal stripe; the dorsal tawney olive band and the lateral brownish-black band continue on each side of the tail as a dusky stripe tapering off and disappearing about the middle of the tail and bordered below by a similarly tapering and disappearing pure white stripe beginning at the posterior insertion of the femur and basally margined below by dusky; iris dark brown with an outer pale brown ring.

Another specimen (No. 26766, U.S.N.M., collector's No. 9076), same date and locality, was exactly like the above except that the underside of the body instead of being washed with bluish was suffused with flesh color, and the inky throat spot was absent.

CADEA BLANOIDES Stejneger.

Figs. 77 to 80.

This is the species usually known as *Amphisbaena punctata* Bell, 1828, a name preoccupied by Prince Max von Wied four years



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FIGS. 77–80.—CADEA BLANOIDES. 2 × NAT. SIZE. NO. 27845, U.S.N.M. SAN DIEGO DE LOS BAÑOS.

earlier for a Brazilian species. Finding, moreover, that Gray was correct in considering the Cuban species as the type of a distinct genus, I changed the name to *Cadea blanoides*.[1]

Palmer and Riley secured specimens at San Diego de los Baños and at Guanajay.

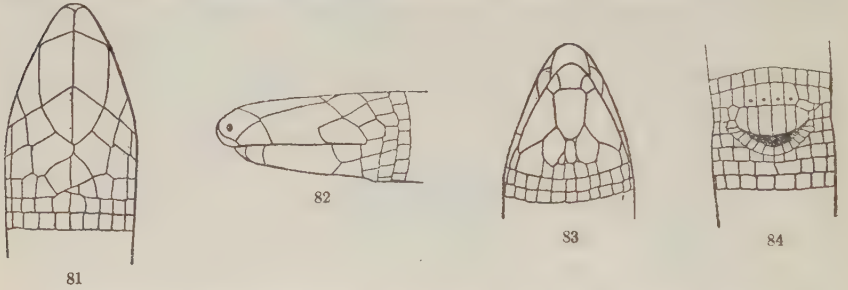
AMPHISBAENA CUBANA Peters.

Figs. 81 to 84.

Unlike the foregoing species, this one is closely allied to others inhabiting Haiti, Porto Rico, the Virgin Islands, and eastern South

[1] Proc. Biol. Soc. Washington, vol. 29, Apr. 4, 1916, p. 85.

America, and the chief difference from these is the unique and curious fusion of the ocular shield with the second supralabial, a character which not only holds good in the types and the two specimens here



FIGS. 81-84.—AMPHISBAENA CUBANA. 4 × NAT. SIZE. NO. 26364, U.S.N.M. MATANZAS.

recorded, but also in 26 specimens from near Cienfuegos collected by and reported on by Doctor Barbour.[1]

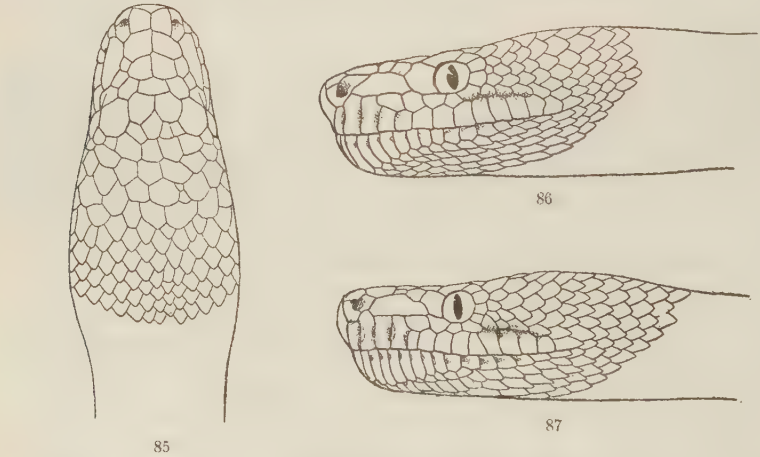
Two specimens were collected by Mr. J. W. Daniel, jr., at Matanzas on February 10, 1899, and presented to the United States National Museum.

SERPENTES.

EPICRATES ANGULIFER Bibron.

Figs. 85 to 87.

Epicrates striatus, of Haiti, differs from *E. angulifer*, of Cuba, normally and most conspicuously by the absence of a complete ring



FIGS. 85-86.—EPICRATES ANGULIFER. ⅔ × NAT. SIZE. NO. 27498, U.S.N.M. SAN DIEGO DE LOS BAÑOS.—87. SAME SPECIES, ⅔ × NAT. SIZE. NO. 10416, U.S.N.M. CUBA.

of scales around the eye, two labials as a rule touching the eye. Usually it has only one scale intercalated between the supralabials

[1] Mem. Mus. Comp. Zoöl., vol. 44, No. 2, March, 1914, p. 317.

and the loreal while *E. angulifer*, as a rule, has two. Moreover, in the latter species three suboculars touch the eye.

None of these conditions, however, are without exceptions. Thus a true *E. striatus* figured by Jan [1] has two scales between loreal and labials, and one of our specimens of *E. angulifer*, the one here figured (fig. 87), has only one; but in the former the labials touch the eye, and in the latter they are excluded by three suboculars. On the strength of a young specimen in the Hamburg Museum, Doctor Zenneck [2] would unite the two species because it has two suboculars shutting out the labials from the eye. This specimen (Hamburg Mus., No. 1410*a*) I have been able to examine, thanks to Doctor Pfeffer's kindness. I can affirm that it is only a slightly abnormal *E. striatus*. The suboculars are very narrow and only two in number, and there is only one intercalated shield between loreal and labials. The characters distinguishing *E. striatus* and *E. angulifer* are not limited to the above, however, for *E. angulifer* has a marked depression on the upper portion of the supralabials behind the eyes; the occipital and temporal shields as well as those on the snout are larger; and there are also differences in the color pattern.

Palmer and Riley collected specimens at San Diego de los Baños and at Guanajay.

TROPIDOPHIS MELANURA (Schlegel).

One specimen was collected at El Guamá, Pinar del Rio, on March 26, 1900, by Palmer and Riley, and another by Bowdish on January 11, 1902, at Guamá.

I am inclined to regard *Tropidophis bucculenta* (Cope), from Navassa Island, as belonging near *T. melanura* rather than to *T. maculata*, though forming a distinct species. I have examined the type material (No. 12377, U.S.N.M.) and find the scale formulas of the three specimens to be as follows:

Scale rows.	Ventrals.	Caudals.	Supralabials.
27	186	27	10
25	180	30	10
25	183	29	10

I would call attention to the number of caudals, which is less than in any specimen of *T. melanura* or *maculata* which I have examined. The brownish stripes seen in *T. melanura* are plainly visible in all three specimens.

In this connection it may be well to call attention to the fact that in these snakes the characters supplied by the head-shields can not be expected to be without exceptions. A convincing demonstration

[1] Icon. Ophid., livr. 6, pl. 6.

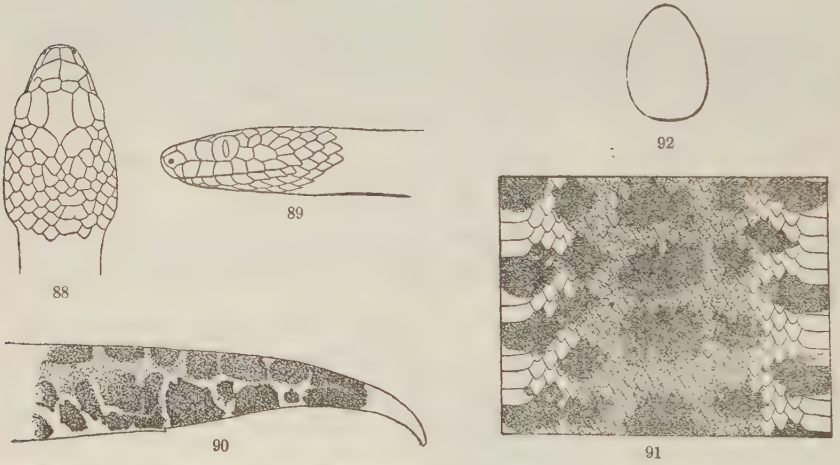
[2] Zeitschr. Wiss. Zool., vol. 64, 1898, p. 60.

of this truth has been made above in the case of the Cuban and Haitian species of *Epicrates*, and I believe that the same holds good to some extent in the case of the Cuban *Tropidophis maculatus* (Bibron) and the Haitian *T. haetianus* (Cope). The museum has recently received two specimens of the latter collected by Dr. A. Busck in San Francisco Mountain, Santo Domingo (Nos. 35979, 35980). They both have 27 scale rows and lack interparietals. They thus materially strengthen the position taken by me in my paper on the Bahama reptiles (in Shattuck, The Bahama Islands, 1905, p. 336).

TROPIDOPHIS PARDALIS (Gundlach).

Figs. 88 to 92.

This species is easily characterized by the low number of ventrals. In the Cuban specimens in the United States National Museum they



FIGS. 88–90.—TROPIDOPHIS PARDALIS. 2⅔ × NAT. SIZE. NO. 27392, U.S.N.M. EL GUAMÁ, PINAR DEL RIO.—91–92, SAME SPECIES. 1⅓ × NAT. SIZE. NO. 26360, U.S.N.M. MATANZAS.—90 REPRESENTS THE COLOR PATTERN AND SHAPE OF TAIL VIEWED FROM THE SIDE.—91 SHOWS THE COLOR PATTERN ACROSS THE MIDDLE OF THE BODY.—92 SHOWS THE CROSS SECTION OF THE BODY AT THE MIDDLE.

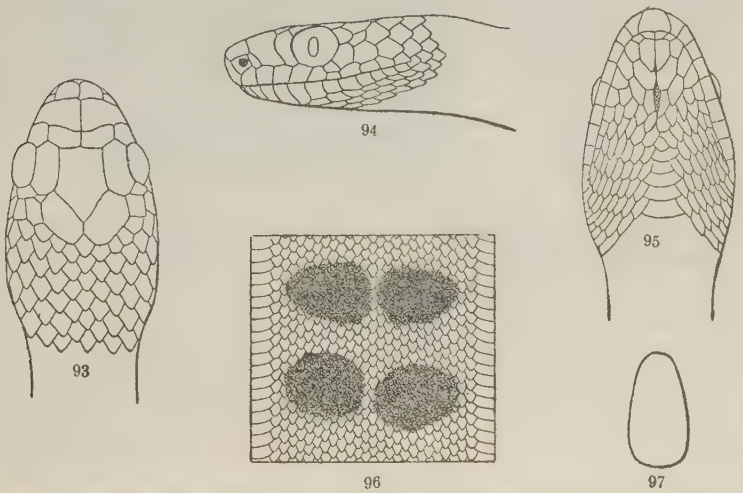
vary between 142 and 158, caudals between 24 and 30, scale rows between 21 and 25. The character of the vertebral row of scales is a very uncertain one in these snakes and apparently of no fundamental importance. In one of the specimens collected by Palmer and Riley at San Diego de los Baños (No. 27849, U.S.N.M.) it is distinctly enlarged. They also obtained a specimen at El Guamá (No. 27392) which has only 21 scale rows. Mr. J. W. Daniel, jr., presented the United States National Museum with a specimen taken at Matanzas, February 10, 1899.

TROPIDOPHIS SEMICINCTUS (Gundlach and Peters).

Figs. 93 to 97.

A specimen of this very distinct species (No. 26361 U.S.N.M.) was collected by Mr. J. W. Daniel, jr., at Matanzas, in 1899. It has 25 scale rows, 209 ventrals, and 30 caudals.

This species is very closely allied to if not identical with Bocourt's *Tropidophis moreletii*.[1] The color pattern is very much alike and the scale formula nearly identical (type of *T. moreletii* has 25 scale rows, 208 ventrals, and 34 caudals) with that of the above specimen. The special characteristic of *T. moreletii* is said to be the "tectiform" shape of the scales, but even in this particular our Cuban specimen



FIGS. 93-95.—TROPIDOPHIS SEMICINCTUS. 2⅔ × NAT. SIZE. NO. 26361, U.S.N.M. MATANZAS.—96-97 1⅓ × NAT. SIZE, REPRESENT COLOR PATTERN AND SECTION THROUGH MIDDLE OF BODY OF SAME SPECIMEN.

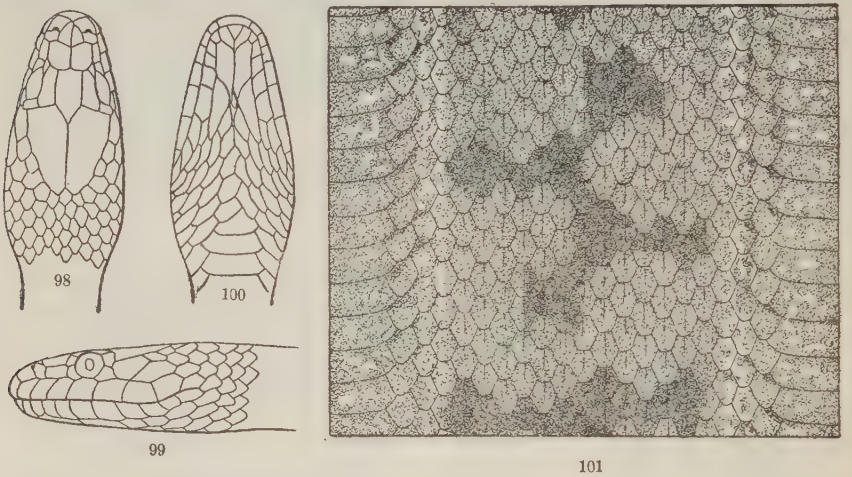
matches it, for the scales of the latter show a decided ridge sometimes approaching a faint keel. The type of *T. moreletii* is said to have been collected by A. Morelet at Vera Paz, Guatemala, but there is no other record from the mainland that I am aware of. However, some mistake may have crept in, for Morelet, as we know, collected also in Cuba. In part confirmation of my doubt as to the correctness of the locality, I may mention that in A. Duméril's Catalogue Méthodique de la Collection des Reptiles du Muséum d'Historie Naturelle de Paris (1851, p. 216), there is listed a *Tropidophis maculatus* collected by Morelet in Cuba, and I suspect that this may be the same specimen which afterwards served as the type of *T. moreletii*.

[1] Bull. Soc. Philom. Paris (7), vol. 9, 1885, p. 113; Miss. Sci. Mexique, Zool., Rept., livr. 11, 1888, pl. 42, figs. 5-5*f*.

TRETANORHINUS VARIABILIS Duméril and Bibron.

Figs. 98 to 101.

Palmer and Riley got this species at Guanajay, San Diego de los Baños, and El Guamá in 1900, and in 1902 Mr. Palmer collected it at El Cobre.

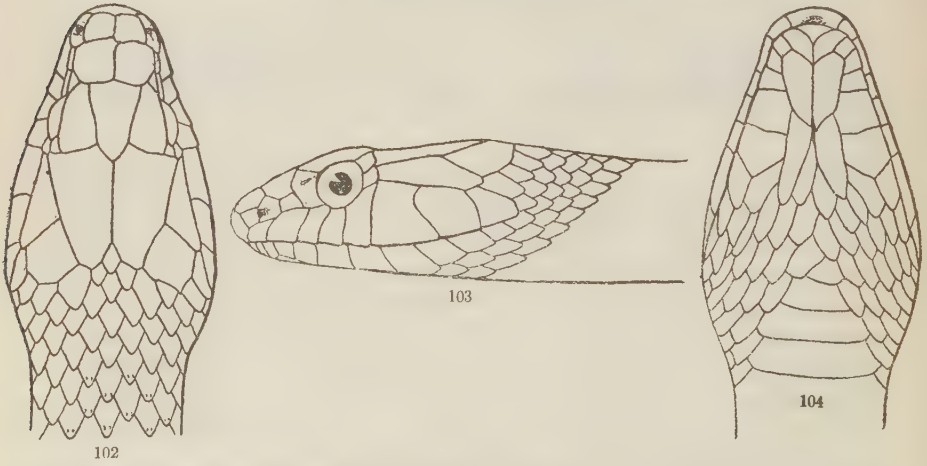


FIGS. 98–101.—TRETANORHINUS VARIABILIS. 1½ × NAT. SIZE. NO. 27393 U.S.N.M. EL GUAM PINAR DEL RIO.—101 SHOWS THE COLOR PATTERN AT ABOUT THE MIDDLE OF THE BODY.

ALSOPHIS ANGULIFER (Bibron).

Figs. 102 to 104.

Of this common species nearly all the parties obtained specimens. The various localities are as follows: Matanzas, El Guamá, Guanajay,



FIGS. 102–104.—ALSOPHIS ANGULIFER. NAT. SIZE. NO. 27501, U.S.N.M. SAN DIEGO DE LOS BAÑOS

San Diego de los Baños, Cabañas, and Isle of Pines. One of the Isle of Pines specimens (No. 28071) shows traces of light spots on the scales on the anterior part of the body, thus tending toward the form *adspersus*.

Measurements of Alsophis angulifer.

Museum and No.	Age.	Locality.	When collected.	By whom collected.	Scale rows.	Ventrals.	Anal.	Subcaudals.	Labials.	Temporals.	Oculars.
U. S. Nat. 10410..	Adult...	Cuba.....	Mar. —, 1880	Prof. E. Poey.	17	172	2	117	8	1+2	1+2
U. S. Nat. 12387..	Adult...	.....do.....	.....	Gundlach..	17	170	2	123	8	1+2	1+2
U. S. Nat. 12387A.	Adult...	.....do.....	.....	.....do.....	17	175	2	....	8	1+2	1+2
U. S. Nat. 26359..	Adult...	Matanzas, Cuba	Feb. 10, 1899	J. W. Daniel, jr.	17	....	2	115	8	1+2	1+2
U. S. Nat. 26362..	Adult...	.....do.....	.....	.....do.....	17	176	2	109	8	1+2	1+2
U. S. Nat. 27397..	Adult...	El Guamá, Cuba.	Mar. 22, 1900	Palmer and Riley.	17	163	2	....	8	1+2	1+2
U. S. Nat. 27398..	Adult...	.....do.....	Mar. 6, 1900	.....do.....	17	170	2	113	8	1+2	1+2
U. S. Nat. 27399..	Adult...	.....do.....	.....do.....	.....do.....	17	171	2	....	8	1+2	1+2
U. S. Nat. 27500..	Adult...	Guanaʻay, Cuba	June 1, 1900	.....do.....	17	176	2	....	8	1+2	1+2
U. S. Nat. 27501..	Adult...	S. Diego de los Baños, Cuba.	Apr. 24, 1900	.....do.....	17	173	2	....	8	1+2	1+2
U. S. Nat. 27646[1].	Adult...	Cabañas, Cuba.	May 15, 1900	.....do.....	17	....	....	....	8	1+2	1+2
U. S. Nat. 27984..	Adult...	Isle of Pines.	July 8, 1900	.....do.....	17	168	2	114	8	1+2	1+2
U. S. Nat. 28071..	Adult...	.....do.....	July 3, 1900	.....do.....	17	170	2	....	8	1+2	1+2
U. S. Nat. 28072..	Adult...	.....do.....	.....do.....	.....do.....	17	166	2	117	8	1+2	1+2

[1] Head and neck only.

ALSOPHIS ANGULIFER ADSPERSUS (Gundlach and Peters).

Doctor Barbour informs me that the specimens from eastern Cuba which he has examined agree in having light centers to the scales, and expresses the opinion that they represent a fairly well characterized form. Our specimens corroborate this conclusion. The ones from Guamá, collected by Bowdish, are dark with light centers. A specimen (No. 29790) taken by Palmer at El Cobre on February 22, 1902, is quite light, because the light central spots occupy nearly the whole scale, leaving only the margins dark, nearly blackish, on the anterior portion of the body.

Measurements of Alsophis angulifer adspersus.

Museum and No.	Age.	Locality.	When collected.	By whom collected.	Scale rows.	Ventrals.	Anal.	Labials.	Temporals.	Oculars.
U. S. Nat. 29781[1]..	Adult...	Guamá, Cuba....	Jan. 1, 1902	B. S. Bowdish.	....	....	....	8	1+2	1+2
U. S. Nat. 29782[1]..	Adult...	.....do.....	.....do.....	.....do.....	....	....	....	8	1+2	1+2
U. S. Nat. 29783...	Adult...	.....do.....	Jan. 2, 1902	.....do.....	17	177	2	8–9	1+2	1+2
U. S. Nat. 29790...	Adult...	El Cobre, Cuba..	Feb. 22, 1902	Wm. Palmer	17	175	2	8	1+½	1+2

[1] Head only.

LEIMADOPHIS ANDREAE (Reinhardt and Lütken).

Figs. 105–107.

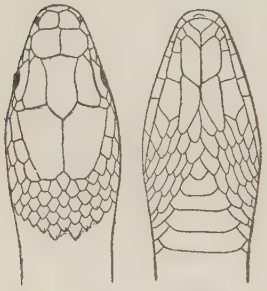
When Barbour described his *Leimadophis nebulatus* [1] he had apparently only seen specimens from the Isle of Pines, the type-locality, and from the western part of the Cuban main island typical of *L.*

[1] Ann. Carnegie Mus., vol. 10, Jan. 31, 1916, p. 305, pl. 28, figs. 1–2.

andreae (type-locality, Habana). Having at least 20 specimens of the latter and seven of the former and finding the variation of the color pattern in the two forms very slight throughout this large series, he was quite justified in diagnosing them under different names.

In a series of 20 specimens in the United States National Museum from the two extreme ends of Cuba proper and also from the Isle of Pines, a different state of affairs is revealed.

A topotype of *T. nebulatus* (No. 28036) collected by Palmer and Riley at Nueva Gerona, Isle of Pines, July 5, 1900, agrees very well with Barbour's description and figure of this form. The white lateral spots on the anterior part of the body have a tendency to become elongate on the fourth and fifth scale rows on each side, and on the posterior part they actually fuse with a distinct white dorso-lateral stripe.



105 107

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FIGS. 105–107.—LEIMADOPHIS ANDREAE. 2× NAT. SIZE. NO. 26764 U.S.N.M. SANTIAGO DE CUBA.

Palmer and Riley's specimens from El Guamá, Pinar del Rio (Nos. 27394–5), San Diego de los Baños (Nos. 27853–6), and Cabañas (Nos. 27640–1), as well as one recently collected by Mr. J. B. Henderson and Dr. Paul Bartsch, at La Mulata (No. 51845), all in western Cuba, agree with Barbour's description and figure of *L. andreae* and with Reinhardt and Lütken's original description of this species, and show at most some scattered hair-fine white margins to some of the dorsal scales.

I turn now to the specimens from eastern Cuba.

A male from Santiago de Cuba (No. 26764, U.S.N.M.) is unique in having the back crossed from ventrals to ventrals by numerous (more than 80) light cross bars formed by the narrow white margins to the scales. The black intervals are slightly wider than the light cross bars. The white margin is possibly slightly emphasized on the fifth scale row on each side, but there is no noticeable light line except on each side of the tail.

Bowdish, in the winter of 1901–2, collected four specimens at Guamá. Of these No. 29756 is very much like our topotype of *L. nebulatus* mentioned above and nobody would for an instant regard them as belonging to different species. Moreover, they both resemble greatly Bibron's figure[1] of what he called *Coluber cursor*, or *Dromicus cursor*, from Cuba (but without definite locality). The other three specimens are an elaboration and exaggeration of this type and that of the Santiago specimen culminating in No. 29780 which has about 50 distinct white cross bands on the body, with

[1] Hist. Fis. Pol. Hist. Nat. Cuba, Atlas, 1842, pl. 28.

broader, more rhomboidal black interspaces caused by the widening of the white band on the fifth scale row, thus recalling the lateral stripe of the other specimens and actually continuing as such on the second scale row of the tail.

From the above material one might be tempted to establish three somewhat ill-defined subspecies—namely, the melanistic *Leimadophis andreae andreae* from western Cuba, *L. andreae nebulatus* from the Isle of Pines, and a third, characterized by numerous definite whitish crossbars, from eastern Cuba, were it not for a specimen (No. 29850) collected by Palmer on January 30, 1902, at Baracoa, near the extreme eastern end of the island. This specimen is a typical *L. andreae* with no indication of white blotches or cross bands. The only difference is that it has a narrow pale line on the fifth scale row and that the whitish head pattern is almost obliterated.

Nothing need to be said about the specimens with the general locality "Cuba" except that the specimen (No. 6183) which the museum received in 1863 from the Paris museum under the name of *Dromicus fugitivus* is much more typical than Cocteau's figure, and exactly like the specimen figured by Jan.[1]

A young specimen (No. 27398) collected by Palmer and Riley at El Guamá, March 26, 1900, is worthy of mention as being a partial albino of the typical form, in which the black is absent, the back being a medium tawny gray.

While I do not attach much importance to the discrepancy in the number of ventrals and subcaudals shown in the table below because of the small number of specimens from eastern Cuba, it may be well to call attention to the fact that both the ventrals and subcaudals are more numerous, on the average, in the six specimens from the eastern part of the island. The average number of ventrals in our 10 western specimens is 145. Barbour states that in 7 specimens from the Isle of Pines, the average is 143 and in an equal number of Cuban examples in the Museum of Comparative Zoology it is 144.[2] As he apparently had no specimens from eastern Cuba, his figures strongly corroborate those from the United States National Museum specimens.

[1] Icon. Ophid., livr. 23, pl. 5, fig. 2.

[2] Ann. Carnegie Mus., vol. 10, 1916, 306.

Measurements of Leimadophis andreae.

Museum and No.	Age.	Locality.	When collected.	By whom collected.	Scale rows.	Ventrals.	Anal.	Subcaudals.	Labials.	Temporals.	Oculars.
U. S. Nat. 29584	Adult	Guamá, Cuba	Nov. 19, 1901	B. S. Bowdish.	17	153	2	110	8	1+2	1+2
U. S. Nat. 29754	Adult	do	Nov. 30, 1901	do	17	154	2	....	8	1+2	1+2
U. S. Nat. 29756	Adult	do	Dec. 25, 1901	do	17	158	2	121	8	1+2	1+2
U. S. Nat. 29780	Adult	do	Jan. 6, 1902	do	17	153	2	105	8	1+2	1+2
U. S. Nat. 29850	Adult	Baracoa, Cuba	Jan. 30, 1902	Wm. Palmer.	17	153	2	106	....	....	....
U. S. Nat. 26764	Young	Santiago, Cuba	.....	H. B. Parker.	17	150	2	108	8	1+2	1+2
U. S. Nat. 27394	Adult	El Guamá, Cuba	Mar. 6, 1900	Palmer and Riley.	17	145	2	111	8	1+2	1+2
U. S. Nat. 27395	Adult	do	do	do	17	142	2	....	8	1+2	1+2
U. S. Nat. 27396	Half grown.	do	Mar. 26, 1900	do	17	138	2	106	8	1+2	1+2
U. S. Nat. 27640	Adult	Cabañas, Cuba	May 15, 1900	do	17	144	2	91	8-9	1+2	1+2
U. S. Nat. 27641	Adult	do	do	do	17	153	2	106	8	1+2	1+2
U. S. Nat. 27853	Half grown.	San Diego de los Baños, Cuba.	Apr. 14, 1900	do	17	146	2	....	8	1+2	1+2
U. S. Nat. 27854	Half grown.	do	do	do	17	147	2	109	8	1+2	1+2
U. S. Nat. 27855	Half grown.	do	do	do	17	143	2	....	8	1+2	2+2
U. S. Nat. 27856	Half grown.	do	do	do	17	143	2	103	8	1+2	1+2
U. S. Nat. 28036	Half grown.	Nueva Gerona, Isle of Pines.	July 5, 1900	do	17	139	2	....	8	1+2	1+2

ARRHYTON TAENIATUM Günther.

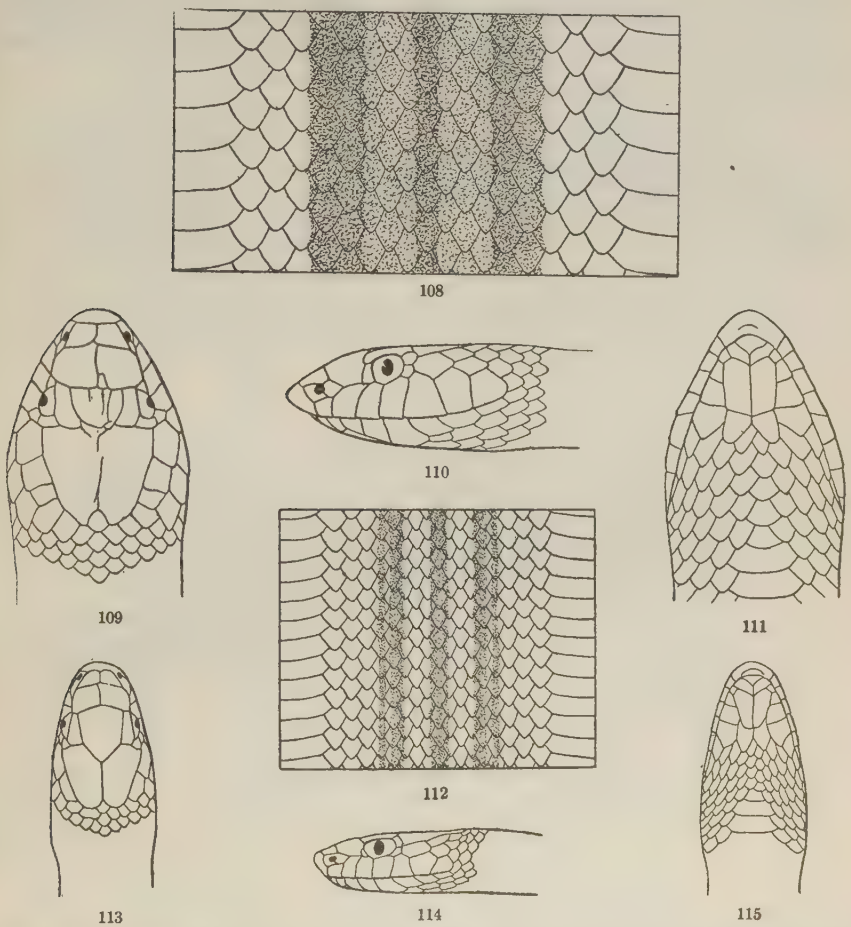
Figs. 108 to 115.

A specimen (No. 29768 U.S.N.M.) was collected by Bowdish at Guamá, on January 7, 1902, "in top soil near hospital," which I refer to this species for the present, at least. It agrees in every respect with No. 29769 which was collected by Doctor Wright, and therefore probably in eastern Cuba. Both differ from the types of *A. taeniatum* and *A. fulvum* in having the preocular so reduced in size as to allow the prefrontals to enter the orbit in the interval between supraocular and preocular, as shown in figure 114, while in the types mentioned the supraocular is broadly in contact with the preocular.[1] There are also some other slight differences in the shape of the snout and the stripes on the body, but in most other respects they are so alike that a specific separation does not seem warranted.

The material available in museums is too limited to allow of any but tentative conclusions as to the status of the species described in this genus, yet thus far the specimens recorded since Boulenger's treatment of it in the second volume of the Catalogue of Snakes in British Museum (1894) bear out the conclusions there set forth. An analysis of the scale formulas of six specimens of *A. taeniatum* and seven of *A. vittatum* (figs. 116 to 119) seems to indicate that the species are not unusually variable. We have here clearly two species—*A. taeniatum* characterized by the absence of a loreal (loreal

[1] See fig. 110 and Boulenger, Cat. Snakes Brit. Mus., vol. 2, pl. 12, fig. 2.

fused with prefrontal) combined with a high number of ventrals (171 to 186, average 177) and subcaudals (69 to 100, average 84.5), while *A. vittatum* has a well-separated loreal combined with few ventrals (112 to 124, average 117.5) and subcaudals (54 to 73, average 64.5).



FIGS. 108–111.—ARRHYTON TAENIATUM. 2⅔ × NAT. SIZE. NO. 12421, U.S.N.M. TYPE OF (A. FULVUM COPE). CUBA.—108 REPRESENTS COLOR PATTERN AT ABOUT THE MIDDLE OF THE BODY.—112–115, SAME SPECIES. 2⅔ × NAT. SIZE. NO. 29769 U.S.N.M. CUBA.—112 REPRESENTS COLOR PATTERN AT ABOUT MIDDLE OF BODY.

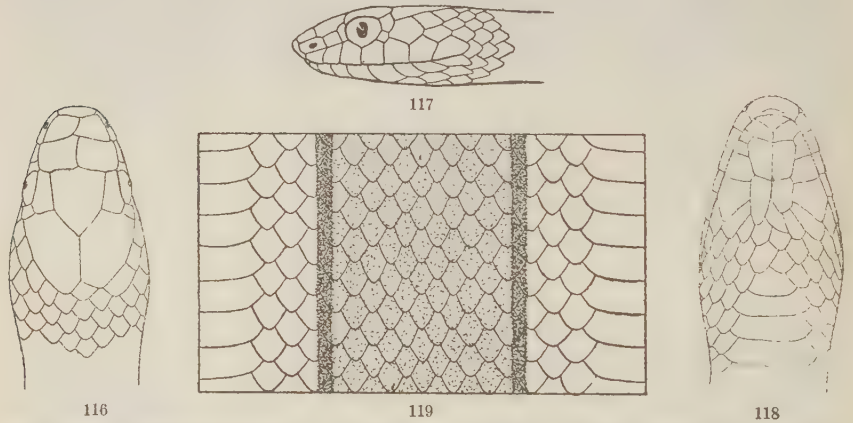
The third species (*A. redimitum*) is known only from Cope's original description [1] and Bocourt's description and figure of a second specimen.[2] No specimen seems to have been found by recent collectors, but in view of the apparent rarity of all these snakes, this does not necessarily mean that the only two specimens known are freaks or extremes of individual variation of one of the other species. The

[1] Proc. Acad. Nat. Sci., Philadelphia, 1862, p. 81.
[2] Miss. Sci. Mexique, Zool., Rept., p. 561, pl. 35, fig. 8.

type is apparently lost and Cope did not give the scale formula of the species. There can be but little doubt that Bocourt described and figured the same form as Cope, and the number of ventrals and subcaudals of this specimen (ventrals 141, subcaudals 120) coupled with the peculiarity of the single prefrontal indicates such a radical difference from either of the other two species as to justify us in retaining *A. redimitum* as a good species. The diagnostic characters of the three species may be briefly tabulated as follows:

Species.	Ventrals.	Caudals.	Loreal.	Prefrontal.
A. redimitum	141	120	1	1
A. vittatum	112–124	54–73	1	2
A. taeniatum	171–186	69–100	0	2

Doctor Barbour has kindly furnished me with the scale formulas of the three specimens of *A. vittatum* and two of *A. taeniatum* collected



FIGS. 116–119.—ARRHYTON VITTATUM. 2⅔ × NAT. SIZE. NO. 5784, U.S.N.M. TYPE OF (A. BIVITTATUM, COPE). CUBA.—119 REPRESENTS COLOR PATTERN AT ABOUT MIDDLE OF BODY.

recently by himself or his collectors in Cuba. They are incorporated in the above table and have materially assisted in clearing up the doubts surrounding these rare snakes.

I have made no special reference to Andersson's *Arrhyton quenselii*,[1] partly because the reference of this snake to *Arrhyton* seems highly problematical, and partly because its habitat is unknown. It is even probable that the specimens upon which it is founded did not come from the West Indies. *A. quenselii* has two nasals, no loreal, two prefrontals, two temporals, 153 to 157 ventrals, and 63 to 67 subcaudals.

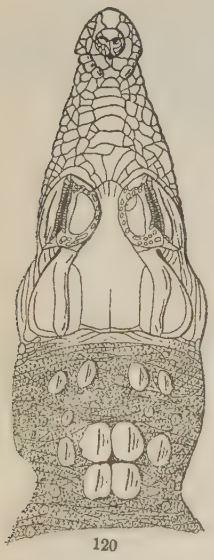
[1] Bih. Svenska Vet. Akad. Handl., vol. 27, sec. 4, No. 5, 1901, p. 15, pl. 1, figs. 5–7.

LORICATA.

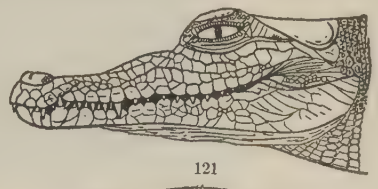
CROCODYLUS ACUTUS Cuvier.

Figs. 120 to 122.

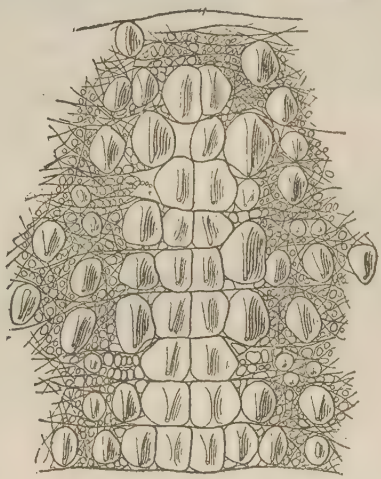
To anybody who has examined Seba's plate,[1] which is the sole basis of Laurenti's *Crocodylus americanus*, the application of the



120



121



122

FIGS. 120–121.—CROCODYLUS ACUTUS, YOUNG. ⅔ × NAT. SIZE. NO. 28760, U.S.N.M. ISLE OF PINES.
122.—NAT. SIZE. REPRESENTS THE ANTERIOR DORSAL SCUTELLATION OF THE SAME INDIVIDUAL.

latter name to the present species seems absurd. That picture is absolutely unidentifiable.

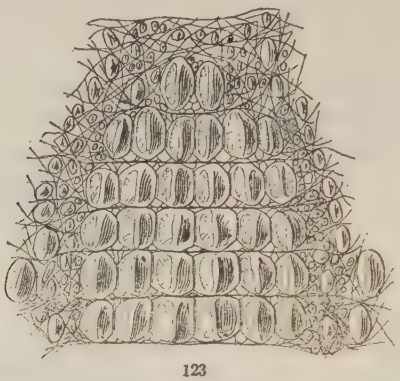
This species was obtained by Palmer and Riley on the Isle of Pines.

It may be interesting in this connection to point out that neither Hornaday nor Jeffries Wyman was the first to record the occurrence of the crocodile in Florida. That was done as early as 1822 by Rafinesque who published the fact in the Kentucky Gazette.[2]

The opinion has recently been expressed that *Crocodylus rhombifer* Cuvier is not a good species, but only young specimens of *C. acutus*.[3] Nothing could be further from the truth. *C. rhombifer* is a very distinct species easily characterized by the different dorsal scutella-

[1] Thesaurus, vol. 1, pl. 106.
[2] New series, vol. 1, No. 29, July 18, 1822, p. 3, col. 2.
[3] Werner, Zool. Jahrb. Syst., vol. 28, p. 265.

tion as may be seen from the figure here presented (fig. 123), which is taken from a much older specimen than the one given of *C. acutus*



123

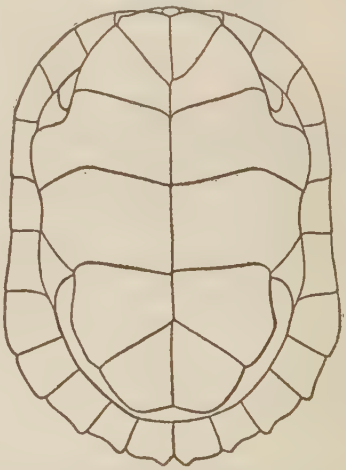
FIG. 123.—CROCODYLUS RHOMBIFER. ½ × NAT. SIZE. NO. 13578. CUBA. REPRESENTS ANTERIOR PORTION OF DORSAL SCUTA.

(fig. 122). The two species may be distinguished by this character alone as follows:

a^1. Dorsal scutes in two median longitudinal regular rows with an interrupted and irregular row of contiguous scutes on each side of the median rows, the keels of the latter being lower than the adjacent ones.....*C. acutus.*

a^2. Dorsal scutes (except anterior and posterior transverse rows) in six longitudinal regular and adjacent rows, the keels of which are of the same height.....*C. rhombifer.*

124



125

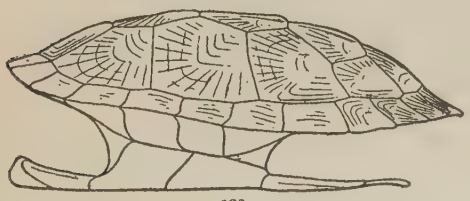
FIGS. 124-125.—PSEUDEMYS PALUSTRIS.—½ × NAT. SIZE. NO. 27639, U.S.N.M. CABAÑAS.

TESTUDINATA.

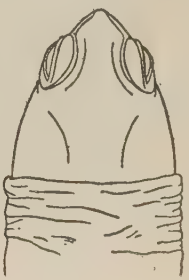
PSEUDEMYS PALUSTRIS (Gmelin).

Figs. 124 to 128.

Two specimens of this, the only fresh-water turtle found in Cuba, were collected at Cabañas on May 17, 1900, by Palmer and Riley.



126



127

128

FIGS. 126–128.—PSEUDEMYS PALUSTRIS. 126.—½ × NAT. SIZE. 127–128.—NAT. SIZE. NO. 27639, U.S.N.M. CABAÑAS.

AN AMERICAN SPECIES OF THE HYMENOPTEROUS GENUS WESMAELIA OF FOERSTER.

By P. R. Myers,

Of the Bureau of Entomology, United States Department of Agriculture.

The description of this species adds an American representative to this rare and little known genus which has hitherto been unrepresented by an American species. The species is apparently a very close relative of *Wesmaelia cremasta* Marshall.

WESMAELIA AMERICANA, new species.

Type-locality.—Hagerstown, Maryland, May 15, 1915, W. R. McConnell, collector.

Type.—Cat. No. 21134, U.S.N.M.

Female.—Length, 4 mm.; reddish testaceous except propodeum and metanotum, which are black; front and vertex shinning, pubescent, rather finely and closely punctured; occiput and cheeks polished, nearly bare and almost impunctate; face below antennae and clypeus pale, finely punctured, sparsely clothed with white pubescence; mandibles pale, dark reddish testaceous at apex; eyes black; ocelli dark brown margined with black; antennae 26 jointed, pubescent, pale reddish testaceous at base to fuscus at apex, joints of flagel cylindrical at base to granose at apex; scape pale, shining, pubescent, indistinctly punctured; carina between antennae; mesonotum shining, closely and irregularly punctured, pubescent; scutellum shining, sparsely pubescent, with sparse indistinct, fine punctures, parasidal furrows broad and rugose; mesopleurae shining with coarse irregular punctures, also rugose areas beneath wings and near base just above the venter; metanotum with distinct, widely separated, longitudinal carinae; propodeum coarsely rugose; abdomen, when viewed dorsally, elliptical, laterally pyriform, slightly darker than mesonotum, smooth and polished, petiole smooth and polished at base and apex, aciculated laterally and indistinctly dorsally at the middle, a little more than the apical half fuscus, the remainder hyaline; ovipositor black, about one-fourth the length of second abdo-

minal segment; legs pale testaceous, last joint of tarsi fuscus; wings, hyaline, nervures and stigma, pale testaceous.

Allotype essentially the same as type except in the shape of the abdomen, which is elliptical when viewed dorsally or laterally; second segment much longer but not compressed laterally; propodeum and metanotum not quite as dark; apex of petiole only fuscus above; antennae not so quite dark toward the apex; eyes, dark brown; antennae, 27 jointed.

Allotype collected at Ithaca, New York. Paratype female at Beltsville, Maryland, June 15, 1913, by Mr. J. R. Malloch, and paratype male at Ottawa, Canada.

A MONOGRAPH OF WEST AMERICAN MELANELLID MOLLUSKS.

By Paul Bartsch,

Curator, Division of Marine Invertebrates, United States National Museum.

The present monograph completes the discussion of the West American Mollusks of the superfamily Pyramidelloideae, the Gymnoglossa, of Malacological Manuals. The superfamily consists of the families Pyramidellidae, which has been previously treated,[1] and the Melanellidae, here considered.

All the members of the superfamily are small mollusks, the largest attaining a size but little more than an inch in length. By far the greater number are elongate conic, but there are some which are quite rotund and others that range between these two extremes. In sculpture they vary from smooth to axially ribbed, to spirally striate or lirate, and combinations of these elements. Anatomically the members of this superfamily are differentiated from the other Prosobranchiate mollusks by the absence or extreme depauperation of the radula.

The members of the family Pyramidellidae are readily distinguished from those of the Melanellidae by the fact that the nepionic whorls are sinistral and tilted; the axis of the early whorls usually

[1] The Pyramidellidae of the Marine Pliocene and Pleistocene Deposits of California, William H. Dall and Paul Bartsch, Mem. Cal. Acad. Sci., vol. 3, 1903, pp. 269–285.

Synopsis of the Genera, Subgenera, and section of the Family Pyramidellidae, William H. Dall and Paul Bartsch, Proc. Biol. Soc. Wash., vol. 17, 1904, pp. 1–16.

Notes on Japanese, Indo-Pacific, and American Pyramidellidae, William H. Dall and Paul Bartsch, Proc. U. S. Nat. Mus., vol. 30, pp. 321–369, pls. 17–26, May 9, 1906.

The Pyramidellid Mollusks of the Oregonian Faunal Area, William H. Dall and Paul Bartsch, Proc. U. S. Nat. Mus., vol. 33, pp. 491–534, pl. 44–48, Washington, December, 1907.

Pyramidellidae of New England and the adjacent Region, Paul Bartsch, Proc. Bost. Soc. Nat. Hist. vol. 24, pp. 67–113, pls. 11–14, February, 1909.

A Monograph of West American Pyramidellid Mollusks, William H. Dall and Paul Bartsch, Bull, U. S. Nat. Mus. No. 68, pp. I–XII and 1–258, pls. 1–30, Washington, Nov. 10, 1909.

More Notes on the Family Pyramidellidae, Paul Bartsch, The Nautilus, vol. 23, 1909, pp. 54–59.

New species of Shells collected by Mr. John Macoun, at Barclay Sound, Vancouver Islands, British Columbia, William H. Dall and Paul Bartsch, Canada Dept. of Mines, Memoir No. 14–N, 1910.

Additions to West American Pyramidellid Mollusk Fauna, with descriptions of new species, Paul Bartsch, Proc. U. S. Nat. Mus., vol. 42, May 17, 1912, pp. 261–289, pl. 35–38.

A Zoogeographic Study based on the Pyramidellid Mollusks of the West Coast of America, Paul Bartsch, Proc. U. S. Nat. Mus., vol. 42, 1912, pp. 297–349.

New species of Mollusks from the Atlantic and Pacific Coasts of Canada, William H. Dall and Paul Bartsch, Bull. No. 1, Victoria Memorial Museum, pp. 139–146, Oct. 23, 1913.

being at right angles to that of the succeeding turns, in the first of which the nuclear whorls are frequently quite strongly embedded. In the Melanellidae, on the other hand, the early whorls are dextral and never tilted or immersed. By far the greater number of the Pyramidellid mollusks are highly sculptured, a feature almost absent in the Melanellidae, where varices mark the strongest axial sculptural element and the spiral sculpture scarcely exceeds that of finely incised lines.

The first Melanellid to be reported from the west coast of America was *Stilifer astericolus* Broderip, a mollusk collected on starfish at Hood Island of the Galapagos group by Hugh Cuming. This is not only described here by Broderip [1] as a new species, but constitutes the type of the genus *Stilifer* there characterized.

Two years after this appeared G. B. Sowerby's paper on the "*Eulimas*," collected by Hugh Cuming and this describes seven new West American forms [2]. These are:

Eulima splendidula Sowerby, from Sancta Elena.
Eulima interrupta Sowerby, from the Gulf of Nocoiyo.
Eulima imbricata Sowerby, from Sancta Elena.
Eulima hastata Sowerby, from Sancta Elena.
Eulima pusilla Sowerby, from Sancta Elena.
Eulima varians Sowerby, from Xipixapi.
Eulima acuta Sowerby, from Montiji Bay.

Eight years later (1852), C. B. Adams published his catalogue of shells collected at Panama, in which he described [3] *Eulima iota, Eulima recta, Eulima solitaria.*

Two years after this Arthur Adams's Monographs of the Genera *Eulima, Niso* and *Leiostraca* were published.[4] Here we find the previously described species redescribed and figured, and some of them referred to other genera than those under which they were originally described:

Eulima hastata Sowerby, page 794, plate 169, figures 7, 8.
Eulima pusilla Sowerby, page 794, plate 169, figures 9, 10, 21.
Eulima iota C. B. Adams, page 798, plate 169, figure 19.
Niso interrupta Sowerby, page 801, plate 170, figure 9.
Niso splendidula Sowerby, page 801, plate 170, figure 8.
Niso imbricata Sowerby, page 802, plate 170, figure 10.
Leiostraca acuta Sowerby, page 803, plate 170, figure 11.
Leiostraca varians Sowerby, page 804, plate 170, figures 23, 24.
Leiostraca recta C. B. Adams, page 804, plate 170, figure 25.

The next to make contributions to the west coast members of this family was Philip P. Carpenter, who devotes pages 438–442 of his

[1] Proc. Zool. Soc. London, 1832, p. 60.
[2] Idem, 1834, pp. 6–8.
[3] Ann. Lyc. Nat. Hist., N. Y., 1852, pp. 198–199.
[4] Sowerby's Thes. Conch., 1854.

Catalogue of Mazatlan Shells, published in 1857, to it. Here we find the following listed:

Eulima? *hastata* Sowerby, page 438.
Eulima ——— sp. ind. (*a*), page 438.
Eulima ——— sp. ind. (*b*), page 438.
Leiostraca? *recta* C. B. Adams, page 439.
Leiostraca? *solitaria* C. B. Adams, page 439.
Leiostraca ——— sp. ind. (*a*), page 439.
Leiostraca ——— sp. ind. (*b*), page 440.
Leiostraca linearis Carpenter, page 440.
Leiostraca? *iota*, var. *retexta* Carpenter.
Leiostraca? *distorta*, var. *yod* Carpenter.

All of the forms attributed to C. B. Adams were later found to be distinct by Carpenter and given names by him.

In 1860 O. A. L. Mörch, in his Beiträge zur Molluskenfauna Central-Amerika's, reached the genus *Eulima* on page 120 [1] and described *Eulima bipartita* Mörch, from Sonsonate, Mexico, and discussed *Eulima distorta* Sowerby and *Eulima recta* C. B. Adams.

The next publication dealing with West American Melanellidae is P. P. Carpenter's Review of Prof. C. B. Adams's Catalogue of the Shells of Panama, from the Type Specimens.[2] Here he discusses on pages 356 and 357 the shells described by C. B. Adams and his own efforts in the Mazatlan Catalogue.

He here raises the name *Leiostraca? iota retexta* Carpenter, previously given to his Mazatlan shell [3] to specific rank. He also separates the Mazatlan shells which he listed under the name *Leiostraca recta* C. B. Adams [4] from the true *M. recta* C. B. Adams, a Panamic species, and gives to the Mazatlanic species the name *Leiostraca involuta* Carpenter, but it will be found that this has a tilted nucleus which places it in the genus *Odostomia*. The shell which he described as *Leiostraca solitaria* he now considers distinct from C. B. Adams *Eulima solitaria*, and he gives it the name *Leiostraca producta*.

The next paper to deal with these shells was also published by P. P. Carpenter. It was his Supplementary Report on the Present State of our Knowledge with Regard to the Mollusca of the West Coast of America.[5] Here, on page 659, we find the following species listed as—

Eulima micans? new species.
Eulima compacta? new species.
Eulima rutila? new species.
Eulima thersites new species.

There are only a few words of description, which would not enable even a specialist to determine the species these names were intended for. They are, however, more fully described later.

[1] Malak. Blät., vol. 6, pp. 120–121.
[2] Proc. Zool. Soc. London, 1863.
[3] Mazatlan Catalogue, 1857, pp. 440–441.
[4] Mazatlan Catalogue, 1857, p. 439.
[5] Rept. Brit. Ass. Adv. Sci. 1863 (1864).

In the following year Doctor Carpenter published his Diagnoses of New Forms of Mollusks Collected at Cape St. Lucas by Mr. J. Xantus.[1] On pages 47 and 48 is his *Eulima fuscostrigata* described as new.

The next effort was also by Carpenter. In his paper Diagnoses Specierum et Varietatum novarum Molluscorum, prope Sinum Pugetianum a Kennerlio Doctore, nuper decesso, collectorium,[2] on page 63, there is a complete description of *Eulima micans* Carpe ter.

In the same year Carpenter published a paper Diagnoses of New Forms of Mollusks from the West Coast of North America first collected by Col. E. Jewett.[3] On pages 396 and 397, *Eulima thersites* Carpenter is fully described.

Still another paper by the same author, Descriptions of New Marine Shells from the Coast of California, appeared the same year.[4] On page 221 of this paper we find *Eulima* (? var.) *compacta* Carpenter and *Eulima* (? var.) *rutila* Carpenter more fully diagnosed.

In 1866 the Monographs on the genera *Leiostraca*, *Eulima*, and *Niso* appeared in Lovell Augustus Reeve's Conchologia Iconica, and while there is only a single new species, *Eulima parva* Reeve, described here, some of the previously described species are here figured. We find:

Leiostraca varians Sowerby, plate 1, figures, 1*a*, 1*b*.
Leiostraca recta C. B. Adams, plate 1, figure 3.
Leiostraca acuta Sowerby, plate 2, figure 7.
Eulima hastata Sowerby, plate 2, figure 9.
Eulima pusilla Sowerby, plate 3, figure 25.
Eulima micans Carpenter, plate 3, figure 33.
Eulima iota C. B. Adams, plate 5, figure 34.
Eulima rutila Carpenter, plate 5, figure 37.
Eulima parva Sowerby, plate 5, figure 41.
Niso imbricata Sowerby, plate 1, figure 3.
Niso splendidula Sowerby, plate 1, figure 7.
Niso interrupta Sowerby, plate 1, figures 8*a*, 8*b*.

The next year De Folin published his paper Les Meleagrinicoles, in which the following Melanellids are described:

Chemnitzia rangii De Folin.
Eulima adamantina De Folin.
Eulima proca De Folin.
Eulima gibba De Folin.
Eulima elegantissima De Folin.
Eulima elodia De Folin.
Eulima opalina De Folin.

[1] Ann. Mag. Nat. Hist., ser. 3, vol. 14, 1864.
[2] Proc. Acad. Nat. Sci. Philadelphia, vol. 17, 1865.
[3] Ann. Mag. Nat. Hist., ser. 3, vol. 15, 1865.
[4] Proc. Cala. Acad. Nat. Sci., vol. 3, 1865.

De Folin unfortunately cites as type-locality for all the shells described in this paper two places—one the environs of *Negritos* (which may mean Negros Island, Philippines), and the other Isle aux Perles—i. e., Margarita Island, Bay of Panama. In order not to miss any West American members, I have quoted all the described forms.

In 1878 G. B. Sowerby published his Monograph on the genus *Stylifer*.[1] In this he redescribes and figures plate 1, figure 3, *Stylifer astericola* Broderip.

Six years later G. B. Sowerby's Monograph on the genus *Stylifer* appeared.[2] In this we find *Stylifer astericolus* Broderip described on page 159 and figured on plate 479, figures 4 and 5.

Two years later Tryon, in his Manual, reached our family.[3] Besides giving a treatment of the superspecific groups he describes and figures all those previously figured. He also gives figures of such as he had represented in his collection and he cites all those known to him to date. From the West Coast of America the following are listed:

Eulima micans Carpenter, page 272, plate 69, figures 29, 30.
Eulima elodia De Folin, page 272.
Eulima parva Sowerby, page 272, plate 69, figures 32, 33.
Eulima adamantina De Folin, page 272.
Eulima gibba De Folin, page 272, plate 69, figure 34.
Eulima opalina De Folin, page 273, plate 69, figure 37.
Eulima proca De Folin, page 273, plate 69, figure 38.
Eulima hastata Sowerby, page 273, plate 69, figure 39.
Eulima iota C. B. Adams, page 274, plate 69, figure 42.
Eulima compacta Carpenter, page 278.
Eulima thersites Carpenter, page 278.
Eulima fuscostrigata, Carpenter, page 278.
Eulima bipartita Mörch, page 278.
Eulima varians Sowerby, page 278, plate 70, figures 65, 67.
Eulima rutila Carpenter, page 279, plate 70, figure 68.
Eulima elegantissima De Folin, page 279, plate 70, figure 69.
Eulima recta C. B. Adams, page 280, plate 70, figure 81.
Eulima acuta Sowerby, page 280, plate 70, figure 82.
Eulima rangii De Folin, page 287, plate 70, figure 20.
Niso splendidula Sowerby, page 287, plate 71, figure 24.
Niso interrupta Sowerby, page 288, plate 71, figures 22, 23.
Niso imbricata Sowerby, page 289, plate 71, figure 31.
Stylifer astericola Broderip, page 290, plate 71, figure 38.

[1] Reeve's Conch. Icon., vol. 20, 1878.
[2] Sowerby's Thes. Conch., 1884.
[3] Tryon's Man. Conch., vol. 8, 1886.

The next Melanellid to be cited is one referred to but not named by von C. Hartlaub, who in his Report on the Dredging Operations off the West Coast of Central America to the Galapagos, to the West Coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U. S. Fish Commission steamer *Albatross* during 1891, Lieut. Commander Z. L. Tanner, U. S. N., commanding,[1] calls attention (p. 147, pl. 4, fig. 25) to a "*Stylifer* (*Mucronalia*) parasitic upon a crinoid found in the Gulf of Panama." This is named by Dr. W. H. Dall in 1908.

In 1899 Edward G. Vanatta published a paper on West American *Eulimidae*[2] in which he described the following:

Eulima lowei Vanatta, page 254, plate 11, figures 9, 10.

Eulima bistorta Vanatta, pages 254–5, plate 11, figures 7, 8.

Eulima compacta Carpenter, pages 255–6, plate 11, figures 11, 12.

Eulima randolphi Vanatta, page 256, plate 11, figures 13, 14.

Eulima micans Carpenter, pages 256–7, plate 11, figures 1, 2.

Eulima rutila Carpenter, plate 11, figures 5, 6.

Nine years later the present writer published A New Parasitic Mollusk of the Genus Eulima.[3] In this *Eulima ptilocrinicola* Bartsch is characterized.

The year following Dr. William H. Dall[4] bestowed the name *Stilifer* (*Mucronalia*) *bathymetrae* upon the mollusk mentioned by Hartlaub in 1895.

In the same year he published his Descriptions of New Species of Mollusks from the Pacific Coast of the United States with Notes on other Mollusks from the same Region.[5] On page 253 of this paper he describes *Eulima* (*?*) *lomana* Dall.

The year following William H. Dall and the present writer published A Monograph of West American Pyramidellid Mollusks.[6] On page 230, *Odostomia* (*Scalenostoma*) *rangii* De Folin is described and figured. This is now transferred to the family Melanellidae.

In 1912 the present writer referred to *Odostomia* (*Scalenostoma*) *rangii* De Folin on page 342; he also described and figured *Odostomia* (*Scalenostoma*) *babylonia* Bartsch (pp. 287–288, pl. 38, fig. 3) of his paper on Additions to the West American *Pyramidellid* Mollusk Fauna, with Descriptions of New Species,[7] which must now be referred to the family here discussed.

The last paper dealing with West American *Melanellids* was published by Frank M. Anderson and Bruce Martin on Neocene Record

[1] Bull. Mus. Comp. Zool. Cambridge, vol. 27, No. 4, 1895.
[2] Proc. Acad. Nat. Sci. Philadelphia, 1908, pp. 254, 257, pl. 11.
[3] Proc. U. S. Nat. Mus., vol. 32, 1907, pp. 255–256, pl. 33.
[4] Bull. Mus. Comp. Zool. Cambridge, vol. 43, 1908, pp. 317–318.
[5] Proc. U. S. Nat. Mus., vol. 34, 1908.
[6] Bull. 68, U. S. Nat. Mus., 1909.
[7] Proc. U. S. Nat. Mus., vol. 42, 1912.

in the Temblor Basin, California, and Neocene Deposits of the San Juan District, San Louis Obispo County.[1] Here the following are described and figured: *Niso* (?) *antiselli* Anderson and Martin, p. 65, pl. 7, fig. 22, and *Eulima gabbiana* Anderson and Martin, p. 68, pl. 7, fig. 20, the last being a *Melanella.*

The group covered by the present monograph is by far the most difficult one that I have thus far treated; the characters are few and confined in the different groups chiefly to differences in outline, flexure, size, weight, and in addition to these, in the case of *Strombiformis* and *Niso*, to color patterns. Whatever there may be of merit in this study, I feel that the credit for it should fall upon the collectors and institutions that have placed all their material in my hands, for without this abundance of material, it would have been entirely impossible to reach the positive conclusions expressed in these pages. Foremost among these I wish to express my thanks to Dr. H. A. Pilsbry, of the Philadelphia Academy of Natural Sciences, for the loan of types, and to Prof. F. B. Loomis of Amherst College, for the loan of C. B. Adams's types from Panama. Also to the California Academy of Sciences for similar favors and the Stanford University for the loan of specimens. Of the private collectors, the material submitted by Mr. and Mrs. T. S. Oldroyd leads easily, both as far as number of species and specimens are concerned. These collections are followed by those of Miss J. M. Cooke; Mrs. Kate Stephens; Dr. Frank Baker; Dr. Ralph Arnold, whose collection is particularly rich in fossil material; Dr. S. S. Berry; Prof. F. W. Kelsey; Mr. F. L. Button; Mrs. Elizabeth E. Johnston; Mr. H. N. Lowe; Mrs. Paula Ball; Mrs. W. H. Eshnaur; and Mrs. Maria Baldridge. It should also be here stated that the splendid collections made by the late Mr. Henry Hemphill and the late Mr. C. W. Gripp, now in other hands, have materially added to the knowledge of these forms.

This paper would be incomplete, did I fail to express my appreciation to Dr. William H. Dall, honorary curator of the section of Mollusks, for his kindly counsel and encouragement while working on this difficult problem.

The photographs used in the illustrations were mostly made by Mr. T. W. Smillie, of the United States National Museum. A few were taken by Mr. John H. Paine, and all of them were retouched by Mrs. E. B. Decker, under my personal supervision.

KEY TO THE WEST AMERICAN GENERA AND SUBGENERA OF THE FAMILY.

Shell umbilicated.....*Niso*, p. 348.
Shell not umblilicated.
  Nuclear whorls forming a mucronate apex.
    Postnuclear whorls globular.....*Stilifer*, p. 352.
    Postnuclear whorls not globular.
      Postnuclear whorls oval.....*Lambertia*, p. 354.
      Postnuclear whorls cylindric.....*Mucronalia*, p. 353.

[1] Proc. Cala. Acad. Sci., ser. 4, vol. 4, 1914.

Nuclear whorls not forming a mucronate apex.
Shell with a strong peripheral keel.....*Scalenostoma*, p. 337.
Shell without a strong peripheral keel.
Inner lip with a twist resembling an obsolete fold.....*Haliella*, p. 336.
Inner lip without a twist resembling an obsolete fold.
Inner lip free, color bands present.....*Eulimostraca*, p. 333.
Color bands absent.....*Sabinella*, p. 333.
Inner lip not free, appressed to the attenuated base.
Shell with color markings.....*Strombiformis*, p. 339.
Shell without color markings.
Shell straight.....*Melanella*, p. 302.
Shell flexed.....*Balcis*, p. 319.

Genus MELANELLA Bowdich.

Melanella Bowdich, Elem. Conch., vol. 1, 1822, p. 27. Type *Melanella dufresnii* Bowdich=*Eulima* Risso, Hist. Nat. Eur. Mer., vol. 4, 1826, p. 123. Type *Eulima elegantissima* Risso=*Melanella polita* (Linnaeus)=*Balcis* Leach, Syn. Moll. Grt. Brit., 1852, p. 200. Type *Balcis arcuata* Leach (=*Melanella distorta* Jeffreys, see Jeffrey Brit. Conch., vol. 4, 1867, p. 207)=*Vitreolina monterosato*, Nom. Conch. Medit., 1884, p. 100. Type *Eulima incurva* (Renier) (=*Melania distorta* Jeffreys, see Bucquoy, Dautzenberg, and Dollfus, Mar. Rous., vol. 2, 1887, p. 769).

The genus as here constituted embraces the white polished mollusks that have the last whorl produced and the inner lip appressed for its entire length, or at least for the greater part of its length, to the attenuated base. The shells may be straight or flexed.

The large amount of material before us shows several species which completely bridge the gap between the straight and the flexed forms; the flexure in these instances being extremely slight. For this reason I have combined *Balcis* with *Melanella*. For convenience sake, however, rather than for difference in structural characters, we may retain the name *Balcis* as a group designation.

Subgenus Melanella Bowdich.

Melanella Bowdich, Elm. Conch., vol. 1, 1822, p. 27. Type *Melanella dufresnii* Bowdich=*Eulima* Risso, Hist. Nat. Eur. Mer., vol. 4, 1826, p. 123. Type *Eulima elegantissima* Risso=*Melanella polita* (Linnaeus).

Melanellas with straight shells.

MELANELLA (MELANELLA) DALLI, new species.

Plate 35, fig. 5.

Shell straight, large, stout, polished, milk-white with irregularly disposed varices. (Early whorls decollated on both of our specimens), later whorls slightly rounded, appressed at the summit. Sutures slightly constricted. Base short, well rounded. Aperture oval, posterior angle acute, outer lip thin, bending slightly forward immediately after leaving the summit, then backward from the

periphery, so that the basal portion is behind the plane of the peripheral edge; inner lip short, moderately thick, curved and slightly reflected over the base, the reflected portion fusing with the thin parietal callus.

Two specimens of this species (Cat. No. 132072), are in the collection of the United States National Museum. They came from the Gulf of California. Both have lost their tips; one of these, the type, has 10½ whorls remaining, and measures—length, 20 mm.; diameter, 7.5 mm. This is the largest species so far known from the west coast of America.

MELANELLA (MELANELLA) MICANS Carpenter.

Plate 34, figs. 1–6.

Eulima micans CARPENTER, Rep. Brit. Ass. Adv. Sci. (1863) 1864, p. 659; Proc. Phila. Acad. Nat. Sci., 1865, p. 63.

Shell straight, elongate-conic, bluish-white when the animal has been removed. When the animal has been allowed to dry in the shell, it appears through the substance of the shell and gives it a mottled brownish aspect. The brownish coloration when present usually extends over the upper half of the specimen. Whorls flattened, decidedly appressed at the summit. Sutures appearing as a very fine impressed line. Base moderately long, well rounded. Aperture oval; posterior angle very acute; outer lip thin at the edge, bent back immediately below the summit, then forward to form a claw-shaped element, the center of which coincides with the periphery; there is another backward deflection of the outer lip at its junction with the inner lip which is moderately strong, curved and twisted and partly reflected over and adnate to the base; parietal wall covered with a moderately thick callus.

The type and another specimen (Cat. No. 14850, U.S.N.M.) were collected by Doctor Cooper, at San Pedro, California. The type has four whorls and measures—length, 9.5 mm.; diameter, 3 mm. An adult specimen (Cat. No. 15317, U.S.N.M.), having 15 whorls, measures—length, 12.5 mm.; diameter, 4 mm. The present form ranges over the Oregonian and Californian faunal areas, decreasing in size from the north, southward. Geologically it is known from the upper and lower San Pedro series of California.

The following specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
2[1]	U.S.N.M.	14850	San Pedro, Cal.	Fig'd, pl. 34, fig. 6.
3	do.	207775	Departure Bay, B. C.	
3	Stanford University		False Narrows, Vancouver Island, B. C.	15 fathoms.
1	U.S.N.M.	215662	San Juan Island, Wash.	
1	do.	109040	Monterey, Cal.	
4	Button	259	do.	
1	U.S.N.M.	56458	Monterey Harbor	8 to 10 fathoms mud bottom.

[1] Type.

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
2	Berry	3075	Monterey Bay	28 fathoms.
3	U.S.N.M.	160086	Catalina Island	
1	do	251070	Pacific Grove	
9	do	128257	San Pedro	
1	Oldroyd		do	Deep water.
3	do		do	Low tide. Sand bottom.
4	Berry	236	San Pedro Bay	3 fathoms.
3	Button		do	1 fathom.
127	Oldroyd		San Pedro	
49	do		do	
1	Johnston		do	
1	U.S.N.M.	322287	do	
15	Lowe	3499	do	
2	do		do	10 fathoms.
104	Eshnaur		Terminal Island	
1	U.S.N.M.	15317	Between San Pedro and San Diego.	Fig'd, pl. 34, fig. 5.
2	Oldroyd		Pacific Beach	Drift.
1	Baker		San Diego	12 to 30 fathoms.
15	U.S.N.M.	46509	do	
1	do	251069	do	
22	do	56765	do	
107	do	322288	do	
4	do	208503	do	
30	Baker		do	
3	do		Below Ballast Point	10 fathoms.
3	do		Outside Zunniga	Dredged.
1	do		False Bay	Do.
15	Kelsey		San Diego Flats	
12	Oldroyd		San Diego	
13	Button		do	
25	Cooke		do	
1	Mrs. Ball		Los Angeles	
20	Baldridge		California	
4	Stephens	2461	San Diego	
27	do	3010	do	
4	Johnston		do	
3	Oldroyd		Point Abreojos, L. C	

FOSSILS.

UPPER SAN PEDRO SERIES.

400	U.S.N.M.	324207	Santa Monica Canyon	
447	Arnold		do	
20	U.S.N.M.	148021	San Pedro	
3	do	324208	Lumber yard, San Pedro	1 fig'd, pl. 34, fig. 4.
7	Arnold		do	
1	U.S.N.M.	324210	Sand Rock, Dead Mans Island.	
4	Arnold		do	
19	do		Lumber yard, San Pedro	
2	U.S.N.M.	324209	San Diego	1 fig'd, pl. 34, fig. 3.
9	Arnold		do	
6	U.S.N.M.	7987	do	
15	do	148627	do	
22	Arnold		Spanish Bight	
109	Stephens	3014	do	
195	U.S.N.M.	148622	Spanish Bight No. 1	
21	do	148628	Spanish Bight No. 2	
32	do	148624	Spanish Bight No. 4	1 fig'd, pl. 34, fig. 1.
14	do	148623	Spanish Bight No. 2	
4	Stephens	5245	Spanish Bight	
4	do	3007	do	
2	do	3005	do	
1	do	3002	do	
4	do	5246	do	
3	do	3004	do	

LOWER SAN PEDRO SERIES.

7	U.S.N.M.	324213	Cerritos	1 fig'd, pl. 34, fig. 2.
19	Arnold		do	
3	U.S.N.M.	324212	Dead Mans Island	
7	Arnold		do	
1	Stephens	2211	San Pedro Railroad cut	

MELANELLA (MELANELLA) MICANS BOREALIS, new subspecies.

Plate 35, fig. 7.

From Vancouver north we have a race of *M. micans* which is uniformly more slender than the race to the south. This may have the subspecific name applied to it above.

The type (Cat. No. 150954, U.S.N.M.) comes from Comox, Vancouver Island. It has 12 whorls and measures—length, 11.3 mm., diameter, 3.3 mm. In addition to this I have seen four specimens: Cat. No. 214039, U.S.N.M. dredged in 13 fathoms, on mud bottom, at St. Paul, Kodiak Island, Alaska; 1, Cat. No. 160084, U.S.N.M. from Kodiak Island; 2, Cat. No. 208774, U.S.N.M. from Alert Bay, British Columbia; 1, Cat. No. 150954, U.S.N.M., from Comox, Vancouver Island, British Columbia; and 1 in Dr. Fred Baker's collection from Departure Bay, British Columbia.

MELANELLA (MELANELLA) OCHSNERI, new species.

Plate 35, fig. 1.

Shell rather large, almost straight, polished, bluish-white. The whorls are very slightly rounded; appressed at the summit, which scarcely shows at its junction with the preceding turns. The basal portion of the preceding whorls show through the substance of the succeeding turns in such a manner as to render this more conspicuous than the suture. Last turn moderately long, well rounded. Aperture very small; posterior angle pinched in, acute, outer lip thick, coming to a sharp edge; inner lip very strong, slightly oblique; the parietal wall covered by a very strong callus which is reflected over and about the columella and renders the peritreme complete.

The type and 42 specimens of this species were collected at Banks Bay, Albemarle Island, Galapagos Islands, on and near sea-cucumbers. The type has lost the nucleus and probably the first two post-nuclear turns. The 12 remaining measure—length, 9 mm.; diameter, 3 mm. The type is in the University of California collection. Four of these specimens are in the collection of the U. S. National Museum, Cat. No. 322282. Two additional specimens, also in the collection of the University of California, came from Sappho Cove, Chatham Island.

This species in a way recalls the northern *Melanella micans* Carpenter, but it differs from it by being stouter and by having a much smaller aperture with a remarkable callus, which is absent in the case of *micans*, or practically so.

MELANELLA (MELANELLA) RUTILA Carpenter.

Plate 35, figs. 2, 3, 6.

Eulima rutila CARPENTER, Rept. Brit. Ass. Adv. Sci. (1863) 1864, p. 659; Proc. Cala. Acad. Nat. Sci., vol. 3, 1865, p. 221.

Shell of medium size, elongate-conic, slender, straight, surface polished, glassy without perceptible sculpture, excepting irregularly distributed varices. Whorls appressed at the summit to such an extent that the suture is scarcely perceptible; the basal portion of the preceding whorls, shining through the substance of the succeeding turns as a false suture; the true suture appearing about one-third of the way between the summit and the false suture above the latter. Periphery of the last whorl rounded, base sloping in such a way as to lend the left outline a somewhat flattened appearance. Aperture large, oval; posterior angle acute; outer lip decidedly protracted between the base and the posterior angle, forming a clawlike extension; inner lip short, moderately stout, somewhat curved, reflected over and appressed to the base; parietal wall covered with a moderately thick callus.

Carpenter's type (Cat. No. 14928, U.S.N.M.) comes from Monterey, California; it has 13 whorls and measures—length, 6.8 mm.; diameter, 1.9 mm.

The following specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
1[1]	U.S.N.M.	14928	Monterey, Cal.	
1	do.	222423	Station 2863, Gulf of Georgia, British Columbia.	67 fathoms, sand bottom, 48.5° bottom temperature.
5	Stanford University.		False Narrows, Nanaimo, Vancouver, B. C.	
1	Baker.		Near Orcas Islands, Wash.	
1	U.S.N.M.	224456	Station 3068, Puget Sound.	135 fathoms, mud bottom.
17	do.	322291	Elliott Bay, N. W. Point Seattle.	
1	do.	251270	Station 2867–2868, off northwestern Washington.	31–37 fathoms, fine gray sand, 46.9° bottom temperature.
1	do.	251269	Monterey, Cal.	
1	Lowe.	3501	do.	
7	Button.		do.	
2	U.S.N.M.	322292	Station 3194, off Estero Bay, Cal.	92 fathoms, gray sand bottom, 45.9° bottom temperature.
2	do.	211822	Station 2901, off St. Rosa Island, Cal.	48 fathoms, mud bottom, 55° bottom temperature.
2	do.	251285	Station 3664, 2 miles off Avalon, Cal.	80 fathoms, fine gray sand.
2	Oldroyd.		Whites Point.	Drift.
37	U.S.N.M.	251267	San Pedro, Cal.	
16	do.	322289	San Pedro.	
5	do.	322293	Off starfish, San Pedro.	Deep water.
2	S. S. Berry.		San Pedro	
31	do.		San Pedro Bay.	15 fathoms.
9	Johnston.		San Pedro.	
9	H. N. Lowe.	3501	do.	10 fathoms.
100	Oldroyd.		Off San Pedro Bay.	
4	do.		Off San Pedro	Berkeley dredging.
2	do.		do.	Deep water.

[1] Type.

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
3	Oldroyd		San Pedro	Off stones.
23	do		Off starfish, San Pedro	Deep water.
4	do		Ventral side of starfish	Sandy bottom.
1	Stephens		San Pedro, Cal.	
19	Eshnaur		Terminal Island	
3	U.S.N.M.	251271	Station 4322, off Point La Jolla, Cal.	110 to 199 fathoms, green mud - shell bottom, 45.4° bottom temperature.
38	do	251272	Station 4323, off Point La Jolla, Cal.	193 to 227 fathoms, soft green mud bottom, 45.8° bottom temperature.
16	do	251274	Station 4325, off Point La Jolla, Cal.	192 to 292 fathoms, green mud, fine sand bottom, 43°–46° bottom temperature.
1	do	211207	Station 4327, off La Jolla, Cal.	263 to 300 fathoms, mud bottom.
1	do	251275	Station 4369, 10 miles off Point Loma Light, Cal.	260 to 284 fathoms, green sand, green mud, rocks, bottom.
1	do	251276	Station 4362, off Point Loma Light.	100 to 159 fathoms, fine gray sand, blue specks bottom.
3	do	251277	Station 4475, 10 miles off Point Loma Light.	142 to 158 fathoms, gray mud bottom.
1	do	210100	Station 4232, off Point Loma, Cal.	62 to 183 fathoms, sand specks, rocks, bottom.
1	do	173074	Northwest of San Diego, 8 miles offshore.	50 fathoms, dark sand bottom.
1	do	251274	Station 4356, San Diego Harbor, Cal.	120 to 131 fathoms, sand, mud bottom.
2	do	211907	Station 3564, San Diego Bay, Cal.	5 fathoms, sand, mud, shell bottom.
35	do	322290	San Diego, Cal	
2	do	268503A	San Diego	
3	do	273992	do	
1	do	250631	do	15 fathoms.
3	do	274022	San Diego, foot of Broadway	Dredged.
3	do	322294	San Diego, Cal	50 fathoms.
7	Baker		San Diego, midspit	
1	do		San Diego	12 to 30 fathoms.
2	do		do	12 to 15 fathoms.
4	do		do	50 fathoms.
2	S. S. Berry		do	Do.
3	Button		do	
3	Cooke		do	
19	Kelsey		do	12 to 30 fathoms.
39	Oldroyd		do	
48	do		San Diego, Pacific beach	Drift.
1	Baker		Near Ballast Point, Cal.	
2	U.S.N.M.	153043	Ocean Beach, Cal	
2	Cooke		do	
7	do		Coronado Island	
2	Baker		South end South Coronado Island.	
2	do		South Coronado Island	7 to 10 fathoms.
2	U.S.N.M.	193660	From *Strongylocentrotus*, station 2935, off southern California.	124 fathoms, fine gray sand bottom, 49.2° bottom temperature.
1	do	251278	Off southern California, station 2936.	359 fathoms, mud bottom, 49° bottom temperature.
3	S. S. Berry		Lower California	Drift.
1	Johnston		do	Do.
1	U.S.N.M.	151935	Station 2826–7–8, Cerros Island, off Lower California.	9½ to 10 fathoms.
2	do	106515	Scammons Lagoon	Mud flats, low tide, rare.
2	Oldroyd		do	
20	U.S.N.M.	322295	San Hipolito Point	
59	Cooke		do	
4	Kelsey		San Hipolito Point, Lower California.	
1	Oldroyd		do	

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
2	U.S.N.M.	322296	Point Abreojos, Lower California.	
2	Oldroyd		do	
1	U.S.N.M.	268637	Station 5678, Magdelena Bay, off Redondo Point, Lower California.	13½ fathoms.
1	Cooke		Magdalena Bay, Lower California.	
181	Baldridge		California	
1	Cooke		do	

FOSSILS.

UPPER SAN PEDRO SERIES.

2	U.S.N.M.	251279	Santa Monica	
13	Arnold		Santa Monica Canyon	
1	U.S.N.M.	324216	Cerritos Island	1 figured, pl. 35, fig. 6.
1	Arnold		do	
2	U.S.N.M.	324217	San Pedro	
4	Arnold		Lumber yard, San Pedro	
2	U.S.N.M.	148626	San Diego, Cal	
1	do	148603	Station 2127, Dosinia beds, lower stratum, railroad crossing foot Twenty-third Street, San Diego.	
1	do	148705	Dosinia beds upper stratum, railroad crossing, foot of Twenty-third Street, San Diego.	
2	Stephens		Twenty-sixth Street, San Diego, Cal.	
1	do		San Diego, Cal	
4	U.S.N.M.	324215	Spanish Bight	
4	do	251286	do	
24	Stephens		do	
1	U.S.N.M.	324214	Station 7498, San Quentin	

LOWER SAN PEDRO SERIES.

2	U.S.N.M.	324218	Sand Rock, Dead Mans Island.	1 figured, pl. 35, fig. 3.
2	Arnold		do	

MELANELLA (MELANELLA) SOLITARIA C. B. Adams.

Plate 35, fig. 4.

Eulima solitaria C. B. Adams, Ann. Lyc. Nat. Hist. New York, vol. 5, 1852, p. 423.

Shell of medium size, broadly elongate conic, milk-white, polished. Early whorls rather well rounded; succeeding turns flattened; marked by exceedingly fine lines of growth only. Suture poorly defined. Periphery of the last whorl somewhat inflated, well rounded. Base moderately long, well rounded. Aperture short, subcircular; posterior angle acute; outer lip decidedly drawn forward in the middle; inner lip stout, strongly curved, reflected over and appressed to the base; parietal wall covered by a thick callus.

The type in the collection of Amherst College, Amherst, Massachusetts, was collected by Prof. Adams on a large holothurian on Taboga Island, Bay of Panama. It has 12 whorls and measures—length, 4.7 mm.; diameter, 1.7 mm.

MELANELLA (MELANELLA) MONICENSIS, new species.

Plate 36, fig. 2.

Shell elongate conic, with perfectly straight-sided spire, yellowish-white, polished, marked by fine lines of growth only. Whorls decidedly flattened, suture very poorly defined. Periphery of the last whorl decidedly angulated. Base short, well rounded. Aperture rhomboid, with a decided angle at the junction of the outer and basal lip; posterior angle acute; outer lip thin, inner short, straight, revolute; parietal wall covered by a thin callus.

The type and another specimen (Cat. No. 251301 U.S.N.M.) come from the Upper San Pedro series at Santa Monica, California. The type has lost the early whorls, the 11 remaining measure—length, 8 mm., diameter, 2.9 mm. Three additional specimens from the same locality are in Mr. Arnold's collection.

MELANELLA (MELANELLA) NECROPOLITANA, new species.

Plate 36, fig. 3.

Shell moderately large, elongate-conic, slender, with perfectly straight-sided spire. First two whorls moderately rounded, separated by well marked suture, the remaining flattened, with scarcely impressed suture. Periphery of the last whorl angulated. Base moderately long, well rounded. Aperture oval; posterior angle acute; outer lip angulated at the junction of the outer and basal lip; inner lip oblique, curved, slightly revolute, reflected over and appressed to the base posteriorly; parietal wall covered with a thin callus.

The type (Cat. No. 251314, U.S.N.M.) comes from Sand Rock, Lower San Pedro Series of Dead Mans Island, California. It has 13 whorls and measures—length, 7.5 mm.; diameter, 2 mm.

MELANELLA (MELANELLA) OLDROYDI, new species.

Plate 36, figs. 5, 6, 7.

Shell rather broadly elongate-conic, bluish-white in the living form, yellowish-white in the fossil, polished, marked by exceedingly fine lines of growth only. The first three whorls well rounded, separated by a moderately impressed suture; the succeeding flattened, separated by a feebly defined suture. Periphery of the last whorl weakly angulated. Base short, well rounded. Aperture oval; posterior angle acute; outer lip angulated at the junction with the basal lip and slightly protracted at the angle; inner lip short, curved, strongly reflected and appressed to the base posteriorly; parietal wall covered with a thick callus.

The type and another specimen (Cat. No. 109641, U.S.N.M.) were collected by Mrs. Oldroyd at San Pedro, California. The type has 14 whorls and measures—length, 9.2 mm.; diameter, 3 mm.

The following specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
2[1]	U.S.N.M.	109641	San Pedro, Cal.	
3	do	251302	Station 2901, off Santa Rosa Island.	48 fathoms, gray sand mud bottom, 55.1° bottom temperature.
10	do	322298	San Pedro	
1	Johnston		do	
10	H. N. Lowe	3499	do	
1	Johnston		do	
28	Oldroyd		do	
7	Eshnaur		Terminal Island	
2	Cooke		Ocean Beach	
1	Button		La Jolla	
8	Oldroyd		Pacific Beach	
9	U.S.N.M.	322297	San Diego	
2	do	274021	San Diego, foot of Broadway	Dredged.
2	do	160087	San Diego Bay	3 fathoms, mud bottom.
2	Cooke		San Diego	
12	Oldroyd		do	
2	Baker		Below Ballast Point	10 fathoms.
1	do		Hipolita Point	
4	Oldroyd		Abrecjos Point	
2	Baldridge		California	

FOSSILS.

UPPER SAN PEDRO SERIES.

10	U.S.N.M.	324223	Santa Monica Cañon	
34	Arnold		do	
8	U.S.N.M.	324219	Santa Monica	
1	do	324220	Lumber yard, San Pedro	1 figured, pl. 36, fig. 5.
6	Arnold		do	
1	do		San Pedro	
3	U.S.N.M.	324221	Spanish Bight	
3	Arnold		do	
18	Stephens		do	
1	U.S.N.M.	324222	Station 7495 San Quentin, Lower California, from bed on stratum of lava, west side of bay.	

LOWER SAN PEDRO SERIES.

4	U.S.N.M.	251313	Dead Mans Island, Cal.	1 figured, pl. 36, fig. 7.
3	Arnold		Sand Rock, Dead Mans Island.	

[1] 1 type.

MELANELLA (MELANELLA) LINEARIS Carpenter.

Plate 36, fig. 4.

Leiostraca linearis CARPENTER, Cat. Maz. Shells, 1858, p. 440.

Shell small, very slender, elongate-conic, yellowish-white, polished; surface marked by exceedingly fine lines of growth only. First four whorls well rounded, separated by a strongly impressed suture, the succeeding turns flattened, rather high, with a scarcely recognizable suture. Periphery of the last whorl feebly angulated. Base rather long, evenly curved. Aperture quite large, broadly oval; posterior angle acute; outer lip decidedly protracted between the posterior angle and the base; inner lip oblique, slightly curved, revolute, the

upper half appressed to the base; parietal wall covered with a thin callus.

Three specimens of this species were dredged by the United States Bureau of Fisheries steamer *Albatross* at station No. 2823 in 26½ fathoms on broken shell bottom, bottom temperature 73°, off La Paz, Lower California. Two of these we have described and figured. The smaller of these two is a young individual of 10 whorls and measures—length, 1.7 mm.; diameter, 0.5 mm. The adult has eight whorls, having lost the early turns, and measures—length, 2.6 mm.; diamater, 0.8 mm.

Carpenter's type, which is in the British Museum, Liverpool collection, Tablet 2025, is a young specimen, having nine whorls, which measure—length, 1.8 mm.; diameter, 0.55 mm.

The following additional specimens, all dredged by the United States Bureau of Fisheries steamer *Albatross*, in the Gulf of California, have been examined. 1, specimen (Cat. No. 191567, U.S.N.M.), at stations 2826 to 2828, near La Paz, in 9½ to 10 fathoms, on shell bottom; 1 (Cat. No. 251300, U.S.N.M.), off Cerralvo Island, station 2822, in 21 fathoms, on gray sand and broken shell bottom, bottom temperature 73°.

MELANELLA (MELANELLA) PANAMENSIS, new species.

Plate 36, fig. 1.

Shell small, elongate-conic, yellowish-white, polished, marked by exceedingly fine lines of growth only. The first three whorls well rounded, separated by a well-impressed suture, succeeding turns flattened, with poorly defined suture. Periphery of the last whorl decidedly angulated. Base short, well rounded. Aperture small, broadly oval; posterior angle acute; outer lip angulated at the junction with the basal lip; inner lip very oblique, stout, slightly curved, reflected over and appressed to the base posteriorly; parietal wall covered with a thick callus.

The type (Cat. No. 251312, U.S.N.M.) was dredged by the United States Bureau of Fisheries steamer *Albatross* at station 2794, in the Bay of Panama, in 62 fathoms on gray sand and broken shell bottom, bottom temperature 59.6°. It has lost the first whorl; the nine remaining measure—length, 2.8 mm.; diameter, 1 mm.

MELANELLA (MELANELLA) RECTA C. B. Adams.

Plate 39, fig. 3.

Eulima recta C. B. Adams, Ann. Lyc. Nat. Hist. New York, vol. 5, 1852, p. 423.

Shell acicular, bluish-white. Early whorls slightly rounded, the later ones decidedly flattened, appressed at the summit, marked by exceedingly fine lines of growth only. Suture scarcely indicated. Periphery of the last whorl well rounded. Base produced, well

rounded. Aperture very elongate-ovate; posterior angle very acute; outer lip pinched immediately below the summit, and slightly protracted in the middle to form a short, claw-like element; inner lip stout, almost straight, reflected over and appressed to the attenuated base; parietal wall covered with a moderately thick callus.

Professor Adams collected five specimens at Taboga Island, in the Gulf of Panama. The type and two of these are in the collection of Amherst College, Amherst, Massachusetts. The type has lost probably the first three whorls. The 10 remaining measure—length, 10.4 mm.; diameter, 2.7 mm. A younger specimen of 12 whorls measures—length, 8.7 mm.; diameter, 2.3 mm.

MELANELLA (MELANELLA) RANDOLPHI Vanatta.

Plate 37, fig. 4.

Eulima randolphi VANATTA, Proc. Phila. Acad. Nat. Sci., 1899, p. 256, pl. 11, figs. 13, 14.

Shell moderately large, rather broadly conic, straight, polished, marked by exceedingly fine lines of growth and scarcely perceptible microscopic spiral striations; bluish white, except where the dry animal within shines through the shell, there it appears light brown. Nuclear whorls, scarcely differentiated from the succeeding turns; post-nuclear whorls, moderately well rounded, separated by a slightly impressed suture. Periphery of the last whorl, well rounded, base rather short, moderately well rounded. Aperture oval; posterior angle acute; outer lip thin, drawn slightly forward in the middle between the posterior angle and the base; parietal wall covered by a thin callus.

The type and six specimens (Cat. No. 73729), Philadelphia Academy of Natural Sciences, were collected by Mr. Randolph at Unalaska, Aleutian Islands. The type has 9 whorls and measures—length, 7 mm.; diameter, 2.6 mm.

The following specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
7[1]	Phila.Acad.Nat.Sci.	73729	Unalaska	
6	U.S.N.M.	100145	do	
1	do	100085	Kyska	
1	do	214036	Kyska Harbor	
2	do	214037	Constantine Harbor, Amchitka.	
2	Berry		Dutch Harbor, Unalaska	
36	U.S.N.M.	200300	do	
6	Button		do	
7	U.S.N.M.	151597	Unalaska	
9	do	251263	Station 2862, off Vancouver Island.	238 fathoms, sand bottom, 44.7° bottom temperature.
1	Kelsey		Puget Sound	
1	Baker		do	
2	Oldroyd		do	

[1] 1 type.

MELANELLA (MELANELLA) CALIFORNICA, new species.

Plate 37, fig. 1.

Shell elongate-conic, straight, polished, marked by exceedingly fine lines of growth and scarcely perceptible microscopic spiral striations, bluish-white, except where the dry animal shines through the texture of the shell, there it lends this a rosy flush. Whorls moderately rounded, separated by a slightly constricted suture. Periphery of the last whorl well rounded. Base moderately long, well rounded. Aperture elongate oval; posterior angle acute; outer lip drawn forward between the posterior angle and the base; inner lip slightly curved and partly appressed to the base; parietal wall covered by a thin callus.

The type (Cat. No. 56911, U.S.N.M.) comes from Catalina Island, California. It has eight whorls and measures—length, 6.2 mm: diameter, 2.3 mm.

The present species resembles quite closely *M. randolphi*, but differs from it in being uniformly smaller and more slender, with the aperture proportionately longer than that species. An additional specimen is in Doctor Baker's collection from San Martin.

MELANELLA (MELANELLA) HEMPHILLI, new species.

Plate 37, fig. 6.

Shell straight, stout, elongate-conic, polished, marked by exceedingly fine lines of growth and scarcely perceptible microscopic spiral striations, the two forming an exceedingly fine and very regular incised grating on the surface; bluish white. Whorls moderately rounded, very slightly constricted at the sutures. Periphery of the last whorl well rounded. Base moderately long, but somewhat inflated, well rounded. Aperture small, oval; posterior angle acute; outer lip thin at the edge, which is scarcely at all drawn forward between the posterior angle and the base. Parietal wall covered with a thick callus.

The type and three specimens (Cat. No. 106514, U.S.N.M.) were collected by Henry Hemphill, on mossy rocks between tides, at Point Abreojos, Lower California. The type has 10 whorls and measures—length, 8.3 mm; diameter, 3 mm.

The present species is readily distinguished from the other straight West Coast forms, that have rounded whorls, by its larger size and by the fact that the spiral sculpture is much stronger than in *randolphi*, or *californica*.

The following specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.
4[1]	U.S.N.M.	127554	Point Abreojos, Lower California.
1	Oldroyd		San Diego.
1	do		Todos Santos Bay, Lower California.
10	do		Point Abreojos.
2	do		Lower California.
2	Johnston		Do.
2	Stephens		Without locality.

[1] 1 type.

MELANELLA (MELANELLA) COMPACTA Carpenter.

Plate 37, fig. 3.

Eulima compacta CARPENTER, Rept. Brit. Ass. Sci. 1863, 1864, p. 659; Proc. Cala. Acad. Nat. Sci., vol. 3, 1865, p. 221.

Shell broadly elongate-conic, straight, polished, the surface marked by exceedingly fine lines of growth and scarcely perceptible microscopic spiral striations. Whorls flattened, separated by a scarcely defined suture; in fact, the basal portion of the preceding whorl shines through the substance of the succeeding turn and causes it at this point to appear as the suture. Periphery of the last whorl well rounded. Base moderately long, well rounded. Aperture quite long, oval, posterior angle acute; outer lip thin, protracted a little anterior to the middle between the posterior angle and the base; inner lip slightly curved, rather thick, reflected over and appressed to the base; parietal wall covered by a moderately strong callus.

Carpenter's type (Cat. No. 135176, U.S.N.M.) was collected by Cooper at San Pedro, California. It has lost the first turn; the eight remaining measure—length, 6.8 mm.; diameter, 2.2 mm. Cat. No. 322300, U.S.N.M. contains another specimen from Lower California. Two additional specimens collected by Henry Hemphill, Point Abreojos, Lower California, are in Mr. Kelsey's collection, and two more collected by the same gentleman, in Lower California, are in Mrs. Oldroyd's collection.

MELANELLA (MELANELLA) BALDRA, new species.

Plate 37, fig. 2.

Shell of medium size, broadly, regularly conic, bluish-white. The first two whorls well rounded, the rest almost flat. Decidedly appressed at the summit, polished, marked by exceedingly fine incremental lines only. The basal portion of the preceding whorl shines through the substance of the succeeding turn and gives this the aspect of having a double suture. Sutures faintly marked. Periphery of the last whorl feebly angulated. Base well rounded. Aperture very small, broadly oval; posterior angle acute; outer lip

thick within, thin at the edge, somewhat protracted in the middle; inner lip short, stout, reflected over and appressed to the base anteriorly; parietal wall covered with a thick callus.

The type and another specimen (Cat. No. 322299, U.S.N.M.), come from San Hipolito Point, Lower California. The type has nine and a half post-nuclear whorls and measures—length, 5.1 mm.; diameter, 2 mm.

MELANELLA (MELANELLA) MEXICANA, new species.

Plate 37, fig. 5.

Shell elongate-conic, straight, polished, marked by exceedingly fine lines of growth and scarcely perceptible microscopic spiral striations; bluish-white. Whorls flattened, separated by an ill-defined suture. The basal portion of the preceding whorl, shining through the succeeding turn, gives to this an appearance of having a false suture. Periphery well rounded. Base rather short, well rounded. Aperture moderately long, oval; posterior angle acute; outer lip thin, decidedly protracted halfway between the posterior angle and the base; inner lip oblique, slightly curved, reflected over and appressed to the base; parietal wall covered with a moderately thick callus.

The type (Cat. No. 267304, U.S.N.M.) comes from the Gulf Coast of Lower California. It has 12 whorls and measures—length, 6.4 mm.; diameter, 2 mm.

The present species is much smaller than *M. compacta* and has a much shorter aperture than that species.

The following specimens have been examined:

Number of specimens.	Collection of.	Catalogue number.	Locality.	Remarks.
1[1]	U.S.N.M.	267304	Gulf of California.	
2	do.	268600	South End Angel de la Guardia.	
2	do.	265936	Mulege, Gulf of California.	2 fathoms.
1	do.	267837	Pichilinque Bay.	
7	do.	267813	do.	
7	do.	251280	Off Cacachitas, Gulf of California, station 2823.	26½ fathoms, broken shell bottom.
1	do.	267292	Gulf Coast, Lower California.	
1	do.	23759	Gulf of California.	
1	do.	25319	Acapulco.	

[1] Type.

MELANELLA (MELANELLA) ABREOJOSENSIS, new species.

Plate 40, fig. 4.

Shell small, acicular, bluish-white, semitranslucent. Whorls rather high between the sutures, well rounded, separated by a constricted suture. Marked by extremely fine incremental lines and irregularly spaced varices. Periphery well rounded. Base rather protracted, well rounded. Aperture moderately large; posterior

angle acute; outer lip thick within, thin at the edge; inner lip somewhat curved, slightly twisted, reflected over and appressed to the base; parietal wall covered by a moderately thick callus.

The type and three specimens (Cat. No. 105578, U.S.N.M.) were collected at Point Abreojos, Lower California. The type has nine whorls, and measures—length, 3.1 mm.; diameter, 1 mm. Twelve additional specimens of the same locality are in Mrs. Oldroyd's collection.

MELANELLA (MELANELLA) TACOMAENSIS, new species.

Plate 38, fig. 5.

Shell small, straight, broadly elongate-conic, bluish-white, except where the animal shines through, there it appears golden brown; surface marked by exceedingly fine lines of growth and almost invisible microscopic spiral striations. Whorls flattened, separated by a scarcely defined suture; the basal portion of the preceding whorl shining through the substance of the succeeding turn appears as a conspicuous false suture. Periphery obscurely angulated; base short, flattened, the left margin very obliquely sloping. Aperture moderately large; posterior angle acute; outer lip very thick within, thin at the edge, decidedly protracted a little anterior to the middle between the posterior angle and the base; inner lip very stout, somewhat flexuose, reflected over and appressed to the base; parietal wall covered with a thick callus.

The type (Cat. No. 159268, U.S.N.M.) was collected by Mr. Fisher at Tacoma, Washington. It has 10 whorls and measures—length, 5 mm.; diameter, 2.1 mm. The sloping base gives the basal portion of the shell a decidedly oblique appearance, which distinguishes this form from all the other straight Melanellas from the west coast.

MELANELLA (MELANELLA) GABBIANA Anderson and Martin.

Plate 38, fig. 3.

Eulimella gabbiana Anderson and Martin, Proc. Cala. Acad. Sci., ser. 4, vol. 4, 1914, p. 68, pl. 7, fig. 20.

"Shell very small, slender, and smooth, polished, with numerous whorls; apex acute (broken in the type-specimen), whorls nearly flat, unsculptured; suture appressed, indistinct; base unflattened; aperture ovally elongated; outer lip sharply rounded anteriorly; inner lip concave, incrusted.

"*Dimensions.*—Altitude of the figured specimen, upper whorls lost, 4 mm.; maximum width, 1.3 mm.

"*Occurrence.*—Lower Miocene of Kern River, California, locality 64.

"This species is distinguished by its small size, slender and smooth form and its long narrow aperture.

"*Type.*—No. 143, Cal. Acad. Sci., in the bottom of a small canyon about 1¼ miles due north of Barker's ranch house, Kern County, California.

"Named in honor of William Gabb."

MELANELLA (MELANELLA) RETEXTA Carpenter.

Plate 38, fig. 1.

Leiostraca retexta CARPENTER, Proc. Zool. Soc. London, 1863, p. 356.
"*Leiostraca ? iota*, var. *retexta* CARPENTER, Cat. Maz. Shells, 1857, p. 440. Comp. *Eulima iota*, C. B. Adams, Pan. Shells, No. 290, pp. 198, 317.—SOWERBY, Thes. Conch. in loco.—H. and A. ADAMS, Gen. Rec. Moll., vol. 1, 1854, p. 236.

"*L.? iota, axi recta.*

"The form above indicated accords somewhat better with the Panama species than with the British, but is entirely without twist. The British specimens are also sometimes straight. The shells in this genus afford so very few distinctive characters that no species can be certainly established without an accurate knowledge of the animals. The only two specimens found vary in proportion; the smaller, with 6 normal turns, measuring long., '06; lat., '028 inches; the larger, long., '087; lat., '033 inches.

"Habitat.—Mazatlan; extremely rare, off *Spondylus;* L'pool Col.

"Tablet 2026 contains the larger specimen."

I have not seen specimens referable to this subspecies, and quote Doctor Carpenter's description and give an unpublished camera lucida drawing made by him of the type.

MELANELLA (MELANELLA) PUSILLA Sowerby.

Plate 38, fig. 2.

Eulima pusilla SOWERBY, Proc. Zool. Soc. London, 1834, p. 8.
Eulima pusilla SOWERBY, Thes. Conch., 1854, pp. 794–5, pl. 169, figs. 9, 10, 21.

"Straight, subulate, thin, white, transparent; whorls slightly convex; aperture elongate-oval, pointed posteriorly.

"Sancta Elena. (Mus. Cuming.)"

I have seen no specimens agreeing with this species and have copied Sowerby's description and figure.

MELANELLA (MELANELLA) HASTATA Sowerby.

Plate 38, figs. 4, 6.

Eulima hastata SOWERBY, Proc. Zool. Soc. London, 1834, p. 7.
Eulima hastata SOWERBY, Thes. Conch., 1854, p. 794, pl. 169, figs. 7, 8.

"Whorls flattened, the first opaque and yellowish, the last white and diaphanous, the last whorl subangular; aperture small, oval, pointed posteriorly.

"Sancta Elena. (Mus. Cuming.)"

I have not seen specimens of this species and copy Sowerby's description and figure.

MELANELLA (MELANELLA) PRODUCTA Carpenter.

Plate 39, fig. 5.

Leiostraca producta CARPENTER, Proc. Zool. Soc. London, 1863, p. 357.=*Leiostraca ? solitaria* Carpenter, Cat. Mazatlan Shells, 1857, p. 439. Not *Eulima solitaria* C. B. Adams, Ann. Lyc. Nat. Hist. New York, 1852, p. 423.

Carpenter's manuscript figure, a camera lucida sketch, shows a broadly conic young *Melanella*. I have seen nothing that agrees with it. I add from Carpenter:[1]

"One nearly perfect shell and some fragments answer to the description of this species. It differs from *L. iota* var. *retexta*, in being larger, broader, flatter, with the whorls in different proportion Long. (anfr. ix.), 123, long. spir. '08, lat. '046, div. 23°.

"Hab.—Taboga; a solitary specimen in large *Holothuria;*

"C. B. Adams.—Mazatlan; extremely rare, on *Spondylus;*

"L.'pool Col.

"Tablet 2022 contains the specimen."

And again:[2]

"*L. solitaria* M. 551, * * * agrees in shape with the unique Panama shell, whorl for whorl; but its base and labrum are much more produced anteriorly. For this reason, it may be known as *L. producta.*"

He also states under *Eulima* (? var.) *rutila* Carpenter:[3]

"Closely allied to *Leiostraca producta* Carpenter, Maz. Cat. No. 551, but displays no varices."

MELANELLA (MELANELLA) ELODIA de Folin.

Plate 39, fig. 1.

Eulima elodia DE FOLIN, Les Meleagrinicoles, 1867, pp. 66, 67, pl. 6, fig. 6.

"Shell imperforate, elongate, polished, milky-white, subopaque; spire conoidal, the apex rather obtuse. Whorls 11 to 12, slowly increasing, united by a simple suture, the last whorl approximately two-fifths as high as the entire shell. Aperture cordate, subopaque, rounded at base, the margins a little thickened; the columella feebly reflexed. Long., 0.005; diam., 0.0015.

"This species is like the other *Eulimas*, graceful and elegant in outline, and in the beauty of its luster. It is much elongated; the right side is almost rectilinear; the left is slightly convex, but that does not prevent the shell from appearing conoidal. The apex, although very slightly obtuse, may be said to be acute, because it in no way way clashes with the acuminate outline. The spire is composed of 11 or 12 whorls, which increase very slowly. The final whorl, which is imperforate, is equal to about two-fifths of the total

[1] Cat. Maz. Shells, 1857, p. 439.
[2] Proc. Zool. Soc. London, 1863, p. 357.
[3] Proc. Cala. Acad. Nat. Sci., vol. 3, 1866, p. 221.

altitude. The whorls are united by a simple suture, which may be called a very clearly and feebly impressed line. The aperture is slightly oblique, and cordate; its margins are smoothly united at the base by a curve which marks the greatest width. Though not sharp, the margins are scarcely at all thickened, the left margin enlarging a little in order to spread out over the side of the last whorl and over the columella, which is enlarged somewhat and seems to be reflected. On certain days *Eulima elodia*, which is milky-white, seems to be almost opaque. Nevertheless it is brilliantly polished and rather diaphanous, so that a certain direction of the light may make all the details of the interior structure apparent, and give to it the appearance of a double suture. It may be said that the true suture is a white ribbon, more strongly marked than that which is posterior to it, and which exactly simulates it. By following this ribbon, at the same time the suture, as far as the angle of the aperture on the final whorl, the illusion will be naturally dissipated.

"*Type locality.*—Negritos; or Margarita Island, Panama."

I have not seen specimens of this species and quote the description and figure.

Subgenus BALCIS Leach.

Balcis LEACH, Syn. Moll. Grt. Brit., 1852, p. 200. Type *Balcis arcuata* Leach. (=*Melanella distorta* Jeffreys, see Jeffrey Brit. Conch., vol. 4, 1867, p. 207.) =>*Vitreolina* Monterosato, Nom. Conch. Medit., 1884, p. 100. Type *Eulima incurva* (Renier) (=*Melania distorta* Jeffreys, see Bucquoy, Dautzenberg, and Dollfus, Mar. Rous., vol. 2, 1887, p. 769.

Melanellas with flexed shells.

MELANELLA (BALCIS) DRACONIS, new species.

Plate 39, fig. 2.

Shell short, very broadly conic, milk-white, flexed in one direction only. The tip of our shell is broken. The first two whorls remaining are slightly rounded, the rest almost flat. Suture well marked. Last whorl rather stout. Periphery decidedly angulated. Base short, somewhat tumid anteriorly, well rounded. Aperture broadly oval; posterior angle acute; outer lip decidedly sinuous, strongly protracted in the middle, to form a decidedly claw-like element; inner lip stout, strongly reflected over and appressed to the base; parietal wall covered by a rather thick callus.

The type (Cat. No. 215766 U.S.N.M.) comes from Dead Man's Island, California. It has seven and a half whorls remaining, and measures—length, 6.1 mm.; diameter, 2.7 mm. This fossil species is the stoutest of the single curved Eulimellas known from the west coast of America.

MELANELLA (BALCIS) MONTEREYENSIS, new species.

Plate 39, fig. 6.

Shell broadly conic, falcate, flexed to the right, bluish-white, with a series of opaque areas, marking varicial streaks. Early whorls well rounded, the later ones slightly rounded, a little more so on the convex than the concave side. Sutures scarcely marked. The posterior determination on the inside of the turns, shines through the substance of the shell and appears as a conspicuous false suture. Periphery weakly angulated. Base short, very strongly curved on the left side. Aperture short, broadly oval; posterior angle acute; outer lip quite strongly protracted at the periphery, inner lip oblique, curved, reflected and appressed to the base; parietal wall covered by a thick callus.

The type (Cat. No. 176623, U.S.N.M.) was dredged by Dr. S. S. Berry, at Pacific Grove, California. It has lost probably the first three turns. The eight remaining measure—length, 5 mm.; diameter, 2.2 mm.

Cat. No. 181307, U.S.N.M., contains a young specimen, collected by Mrs. Merrihew, at Monterey, California.

MELANELLA (BALCIS) PENINSULARIS, new species.

Plate 39, fig. 4.

Shell elongate-conic, very slightly curved, polished, surface marked by exceedingly fine lines of growth and exceedingly regular, very fine, microscopic, spiral striations; bluish-white, except where the animal shines through the substance of the shell, when it appears brown. Whorls separated by a very poorly defined suture, which is inconspicuous compared to the false suture caused by the base of the preceding whorl shining through the substance of the succeeding turn. The whorls are marked at irregular intervals by thickened varices, which are very prominent. Periphery of the last whorl well rounded. Base short, slightly rounded, the left sides sloping very obliquely. Aperture broadly oval; posterior angle acute, outer lip decidedly protracted half way between the posterior angle and the base; inner lip very oblique, moderately strong, slightly curved, reflected over and appressed to the base; parietal wall covered with a thick callus.

The type (Cat. No. 251264, U.S.N.M.) comes from Lower California. It has 11 whorls and measures—length, 5.2 mm.; diameter, 2.2 mm.

The following additional specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
1[1]	U.S.N.M.	251264	Lower California	
8	do	215763	San Diego	
1	do	273993	do	
5	do	127543	San Hipolito Point	
7	do	130613	do	On *Haliotis*.
20	Baker		do	
2	Button		do	
6	Cooke		do	
2	Kelsey		do	
18	Oldroyd		do	
3	U.S.N.M.	106516	Point Abreojos	
17	Oldroyd		do	
2	Cooke		Magdalena Bay	
1	U.S.N.M.	268583	Lower California	
1	Johnston		do	
3	Oldroyd		do	

[1] Type.

MELANELLA (BALCIS) LASTRA, new species.

Plate 40, fig. 3.

Shell small, conic, only very slightly flexed; bluish-white, semi-translucent; polished, marked by exceedingly fine lines of growth only. The first three whorls well rounded, separated by a well-impressed suture, the rest very slightly rounded, with a scarcely defined suture. Periphery well rounded. Base short, well rounded. Aperture very broadly oval; posterior angle acute; outer lip decidedly protracted a little anterior to the middle; inner lip short, curved, reflected over and appressed to the base; parietal wall covered with a thick callus.

This species is similar to *M. peninsularis*, but is uniformly more slender, with the varices much less conspicuously marked.

The type and three specimens (Cat. No. 105519, U.S.N.M.) were collected by Mr. Henry Hemphill at Point Abreojos, Lower California. The type, an adult shell, which has lost probably the first two whorls, retaining eight, measures—length, 4.1 mm.; diameter, 1.6 mm, Another, an immature specimen of nine whorls, measures—length, 2.6 mm.; diameter, 1 mm.

The following additional specimens have been examined:

Number of specimens.	Collection of—	Catalogue No.	Locality.	Remarks.
5[1]	U.S.N.M.	105519	Point Abreojos	
2	do		San Pedro	Deep water, off stones.
4	Oldroyd		do	Do.
2	Berry		San Hipolito Point	
6	U.S.N.M.	105577	Point Abreojos, Lower California.	
1	Cooke		Magdalena Bay	

[1] Type.

MELANELLA (BALCIS) ARNOLDI, new species.

Plate 40, fig. 8.

Shell broadly conic, with very slight flexure; milk-white. Early whorls well rounded, separated by a well-constricted suture, later ones almost flattened, appressed at the summit with a very poorly defined suture. Periphery weakly angulated. Base short, well rounded. Aperture broadly oval; posterior angle acute; outer lip protracted in the middle; inner lip short, slightly sinuous, reflected over and appressed to the base; parietal wall covered with a thick callus.

The type (Cat. No. 215765, U.S.N.M.) was collected at Sand Rock, Lower San Pedro Series, Dead Man's Island, California. It has 11 whorls and measures—length, 5.5 mm.; diameter, 2.1 mm. Another specimen from the same locality is in Mr. Arnold's collection; still another from San Pedro is also in Mr. Arnold's collection.

MELANELLA (BALCIS) COSMIA, new species.

Plate 40, fig. 6.

Shell very small, broadly conic, flexed to the right; bluish-white; semitransfucent; polished. The first three whorls well rounded, separated by a moderately well-constricted suture; the rest slightly rounded, with scarcely defined suture. Periphery of the last whorl weakly angulated. Base short, well rounded. Aperture very broadly ovate; posterior angle acute; outer lip strongly protracted a little anterior to the middle; inner lip curved, reflected over and appressed to the base; parietal wall covered with a moderately thick callus.

The type and three specimens of this species (Cat. No. 105580, U.S.N.M.) were collected by Mr. Henry Hemphill at Point Abreojos. The type has nine whorls and measures—length, 2.7 mm.; diameter, 1 mm. Mr. Kelsey's collection contains two from the same place, while Mrs. Oldroyd's collection has two from the same locality and two labeled Lower California, without specific locality.

MELANELLA (BALCIS) HALIA, new species.

Plate 40, fig. 2.

Shell very minute, translucent, showing the entire internal structure within, slightly flexed in one direction at the tip. Whorls very evenly rounded, separated by a rather strongly marked suture, polished, without sculpture excepting slightly impressed varicial streaks at irregular intervals. Periphery of the last whorl well rounded. Base short, slightly inflated, well rounded. Aperture small, oval; posterior angle acute; outer lip thin, slightly protracted in the middle; inner lip short, slightly curved, reflected over and appressed to the base; parietal wall covered by a moderately thick callus.

The type (Cat. No. 215767, U.S.N.M.) was collected by Mr. Hemphill at Point Abreojos, Lower California. It has eight whorls and measures—length, 1.8 mm.; diameter, 0.7 mm. Another specimen from the same locality is in Mr. Kelsey's collection, while a third, in Mrs. Oldroyd's collection, comes also from the same place.

MELANELLA (BALCIS) TOWNSENDI, new species.

Plate 40, fig. 1.

Shell small, straight, excepting the tip, which is flexed in one direction, semitranslucent, bluish-white. The first three whorls well rounded, separated by a well-impressed suture. The rest almost flat, with inconspicuous suture. Periphery of the last whorl rounded. Base rather protracted, somewhat flat on the left side, slightly tumid anteriorly. Aperture broadly oval; posterior angle acute; outer lip thick at the edge, decidedly protracted in the middle; inner lip short, curved, reflected over and appressed to the base; parietal wall covered by a moderately thick callus.

The type and another specimen (Cat. No. 267812*a*, U.S.N.M.) were collected by the author in shallow water at Pichilinque Bay, Gulf of California. The type has 13 whorls and measures—length, 3.8 mm.; diameter, 1.1 mm.

MELANELLA (BALCIS) THERSITES Carpenter.

Plate 41, figs. 1, 2, 3.

Eulima thersites CARPENTER, Rept. Brit. Ass. Adv. Sci. (1863) 1864, p. 659; Ann. Mag. Nat. Hist., ser. 3, vol. 15, 1865, pp. 396–7.
Eulima lowei VANATTA, Proc. Acad. Nat. Sci. Phila., 1899, p. 254, pl. 11, figs. 9, 10.
Eulima bistorta VANATTA, Proc. Acad. Nat. Sci. Phila., 1899, pp. 254–5, pl. 11, figs. 7, 8.

Shell broadly conic, rather stout and heavy, polished, shining, usually flexed in one direction only, though sometimes in two. Whorls rather strongly rounded, marked by exceedingly fine incremental lines and irregularly scattered varices only. Sutures strongly marked. Periphery of the last whorl somewhat inflated, well rounded. Base short, well rounded. Aperture oval; posterior angle acute: outer lip thick within, sharp at the edge, and decidedly protracted a little anterior to the middle; inner lip stout, slightly curved, the posterior half reflected over and appressed to the base. Parietal wall covered by a very thick callus which renders the peritreme complete.

Carpenter's type (Cat. No. 11795 U.S.N.M.) comes from Santa Barbara, California. It has lost the early whorls. The six and a half remaining measure—length, 5.1 mm.; diameter, 2.5 mm. An absolutely perfect specimen of 12 whorls measures—length, 6.3 mm.; diameter, 2.3 mm.

In addition to the figure of the type, we are also giving figures of Doctor Vanatta's two species, *Melanella bistorta*, and *Melanella lowei*.

The large amount of material which we have seen of this species makes it impossible for us to consider these distinct forms.

I have seen the following species:

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
1 [1]	U.S.N.M.	11795	Santa Barbara	
3	do	46510	Monterey	
4	do	56893	do	
11	Button		do	
1	Eshnaur		do	12 fathoms.
1	Kelsey		do	
1	Oldroyd		do	
1 [2]	Phila. Acad. Nat. Sci.	65881	Monterey [2]	On starfish.
4	Berry		Monterey, off del Monte	12 fathoms.
1	do		Pacific Grove	
3	U.S.N.M.	215768	Off St. Cruz (off *Haliotis*)	
3	Oldroyd		do	
3	U.S.N.M.	215770	Off Santa Rosa Island, U. S. B. F station 2900.	13 fathoms, sandy bottom.
2	do	215769	Off Catalina Island	
1	Oldroyd		Catalina Island	
4	U.S.N.M.	215771	San Pedro	Deep water.
2	Lowe		do	10 fathoms.
22	Oldroyd		do	
6	do		do	Deep water.
1 [3]	Phila. Acad. Nat. Sci.	57262	Long Beach [3]	
2	Cooke		Ocean Beach	
1	Stephens	2451	Imperial Beach	
1	Cooke		La Jolla	
17	U.S.N.M.	215772	San Diego	
1	Baker		do	15 fathoms.
1	do		do	
1	Berry		do	Do.
2	Cooke		do	
2	Kelsey		do	
1	do		do	Do.
3	Oldroyd		do	
2	Baker		Ballast Point	8 fathoms.
2	U.S.N.M.	226460	Off South Coronado Island	3 fathoms.
2	Baker		South Coronado Island	6 to 8 fathoms.
2	do		do	3 fathoms.
1	do		do	
1	do		do	3 to 6 fathoms.
1	Cooke		do	
2	Oldroyd		Todos Santos	
4	U.S.N.M.	215773	San Hipolito Point	
4	Cooke		do	
4	Kelsey		do	
7	Oldroyd		do	
1	do		Point Abreojos	
1	do		Round Island, Lower California.	
1	Lowe		San Geronimo Island	
	Berry	1411A	Lower California	

[1] Type. [2] Type of *Eulima bistorta* Vanatta. [3] Type of *Eulima lowei* Vanatta.

MELANELLA (BALCIS) COLUMBIANA, new species.

Plate 41, fig. 5.

Shell large, rather stout, polished, with a double flexure; when viewed with the aperture to the front it shows the early whorls bent backward and the succeeding turns flexed to the right. Shell bluish-white, except where the dried animal shines through its substance; there it has a granular, light brown to buff appearance. First three turns well rounded, separated by a well-marked suture, the remaining turns slightly rounded with scarcely defined suture. The posterior termination of the inside of the whorl shines through the shell and

appears as a conspicuous false suture. Surface marked by fine lines of growth only. Periphery of the last whorl weakly angulated. Base strongly rounded on the left side. Aperture very oblique, ovate; posterior angle acute; outer lip decidedly protracted at the periphery; inner lip short, curved, slightly sinuous, reflected over and appressed to the base; parietal wall covered by a thick callus.

The type and four specimens (Cat. No. 207771, U.S.N.M.) were collected by Rev. G. W. Taylor, at Departure Bay, British Columbia. The type has 15 whorls and measures—length, 9.5 mm.; diameter, 3 mm. This is the largest of flexed Melanellas known from the West Coast of America.

Number of specimens.	Collection of—	Catalogue number.	Locality.
12	Taylor		Departure Bay, British Columbia.
1	Baker		Alaska.
1	U.S.N.M.	204016	Bear Bay, Baranoff Island, Peril Strait, Alaska.
3	Stephens		Do.
2	Baker		Departure Bay, British Columbia.
7	Kelsey		Do.

MELANELLA (BALCIS) COMOXENSIS, new species.

Plate 41, fig. 4.

Shell broadly conic, with a double flexure, the early portion being turned back while the later is turned to the right; bluish-white, polished. First two whorls well rounded, separated by a constricted suture, the rest slightly rounded, a little more so on the convex than the concave side, marked by exceedingly fine lines of growth and microscopic spiral striations and occasional varicial streaks, which appear as an opaque spot in the shell. Suture scarcely defined. The posterior limit of the inside of the whorls shines through the substance of the shell and appears as a false suture. Periphery of the last whorl slightly angulated. Base short, strongly rounded. Aperture broadly oval, rather short; posterior angle acute; outer lip protracted at the periphery; inner lip short, slightly curved, strongly reflected and appressed to the base; parietal wall covered with a thick callus.

The type and five specimens (Cat. No. 207773, U.S.N.M.) were collected at Comox, British Columbia, by Rev. G. W. Taylor. The type has 11 whorls and measures—length, 7.1 mm.; diameter, 3 mm.

Twenty-eight additional specimens from the same locality are in Rev. G. W. Taylor's collection.

MELANELLA (BALCIS) MACRA, new species.

Plate 41, fig. 6.

Shell of medium size, slender, with a double flexure. When viewed with the aperture to the front, it shows the early whorls bent backward and the succeeding turns flexed to the right. Shell bluish-white, except where the dried animal shines through its substance; there it has a granular light brown to buff appearance. First four whorls well rounded, with well-impressed suture, the remainder almost flattened, marked by exceedingly fine lines of growth only, and separated by a scarcely visible suture. The posterior limit of the inside of the whorls shines through the substance of the shell and appears as a conspicuous false suture. Periphery of the last whorl weakly angulated. Base somewhat prolonged, well rounded. Aperture long, ovate; posterior angle acute; outer lip considerably protracted, particularly so at the periphery; inner lip stout, curved, reflected over and appressed to the base; parietal wall covered by a thick callus.

The type and three specimens of this species (Cat. No. 207772, U.S.N.M.) were collected by Rev. G. W. Taylor at Departure Bay, British Columbia. The type has 13 whorls and measures—length, 7.5 mm.; diameter, 1.9 mm.

The present species is very similar to *Melanella columbiana*, but uniformly smaller and much more slender.

The following additional specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.
11	Taylor		Departure Bay, British Columbia.
1	Kelsey		Do.
7	Berry		Do.
2	Button		Nanaimo, British Columbia.
2	Stanford University		False Narrows, Nanaimo, Vancouver Island, British Columbia.
1	U.S.N.M.	129124	Seattle, Washington.

MELANELLA (BALCIS) BERRYI, new species.

Plate 42, fig. 3.

Shell elongate-conic, with a double flexure; the first bend when the specimen is viewed with the aperture to the front, is to the right, and the second flexure is backward. The clean shell is bluish-white, but when the animal has been allowed to dry in it, it appears brown. The first two turns well rounded, separated by a constricted suture, the remainder flattened, marked by exceedingly fine lines of growth and very fine microscopic spiral striations. Sutures scarcely perceptible. The posterior limit of the inside of the whorls appears through the

mass of the shell as a false suture. Periphery of the last whorl well rounded. Base short, somewhat inflated anteriorly. Aperture oblique, broadly oval; posterior angle very acute; outer lip strongly protracted between the base and the posterior angle, the greatest extension falling at the periphery; inner lip oblique, slightly sinuous, reflected over and appressed to the base; parietal wall covered with a strong callus.

The type (Cat. No. 216820, U.S.N.M.) was dredged in 12 fathoms off Del Monte, Monterey, California, by Dr. S. S. Berry. It has 12 whorls and measures—length, 6 mm.; diameter, 2 mm.

Cat. No., 193697, U.S.N.M., contains another specimen dredged by the United States Bureau of Fisheries steamer *Albatross*, off Catalina Island.

MELANELLA (BALCIS) PREFALCATA, new species.

Plate 42, fig. 4.

Shell elongate-conic, yellowish-white, doubly flexed, the anterior portion being turned to the right and the tip backward. Early whorls slightly rounded, separated by a well marked suture, the succeeding turns appressed at the summit, moderately rounded on the curved side of the shell and slightly so on the concave side of the spire, marked by exceedingly fine lines of growth only. Sutures scarcely indicated. Periphery slightly angulated. Base somewhat produced, well rounded. Aperture moderately large; posterior angle acute; outer lip decidedly protracted at the peripheral angle; inner lip short, curved, reflected over and appressed to the base; parietal wall covered with a thick callus.

The type (Cat. No. 215774, U.S.N.M.) comes from the Lower San Pedro Series, Sand Rock, Dead Man's Island. It has 11 whorls and measures—length, 6.9 mm.; diameter, 2 mm. Five additional specimens are entered under the same catalogue number and 16 are in Doctor Arnold's collection, by whom they were collected. Three additional specimens without locality are in Arnold's collection.

The species resembles closely *falcata*, but differs from it by its comparatively longer aperture.

MELANELLA (BALCIS) GRIPPI, new species.

Plate 42, fig. 5.

Shell elongate-conic, moderately stout, doubly flexed; the anterior portion is turned to the right, while the tip is bent backward; polished, marked by exceedingly fine lines of growth only; milk-white, except where the dried animal shines through the texture of the shell where it appears yellowish-brown, or where varices cross the whorls, behind which there is always an opaque area. First five whorls well

rounded, separated by a somewhat constricted suture, the remainder, moderately rounded, a little more so on the convex side than the concave. Summit of the whorls appressed, separated by a very ill-defined suture. The posterior termination shows conspicuously through the substance of the shell on the inside of the whorls and appears as a false suture. Last whorl somewhat inflated. Periphery moderately protracted. Base rounded. Aperture ovate; posterior angle acute; outer lip protracted at the periphery; inner lip short, slightly curved, reflected and appressed to the base; parietal wall covered by a moderately thick callus.

The varices of this species practically form a continuous oblique line from the aperture almost to the tip.

The type and five additional specimens (Cat. No. 203665, U.S.N.M.) were collected by Mr. Gripp at Newport, California. The type has 12 whorls and measures—length, 8 mm.; diameter, 2.6 mm.

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
2	U.S.N.M.	215775	Off San Pedro	Deep water.
11	Oldroyd		do	Do.
2	U.S.N.M.	215776	do	75 fathoms, on stones.
8	Oldroyd		do	Do.
7	do		San Pedro	
1	Button		San Diego	15 fathoms.
1	Kelsey		Off San Diego	Do.
9	U.S.N.M.	215777	San Diego	
1	Baker		Off south end of Coronado Island.	12 to 15 fathoms.
2	U.S.N.M.	215778	Point Abreojos	
3	Oldroyd		do	

MELANELLA (BALCIS) TARAVALI, new species.

Plate 42, fig. 2.

Shell very minute, bluish-white, doubly flexed; the anterior portion turned to the right, the tip flexed backward. The first three whorls well rounded, separated by a well impressed suture. The rest almost flat, separated by an inconspicuous suture, marked by exceedingly fine incremental lines only. The last whorl inflated. Periphery well rounded. Base short, well rounded. Aperture broadly oval; posterior angle acute; outer lip thin, slightly protracted in the middle; inner lip short, slightly curved, reflected over and appressed to the base; parietal wall covered by a rather thick callus.

The type (Cat. No. 215779, U.S.N.M.) was collected by Mr. Hemphill at Point Abreojos, Lower California. It has nine whorls and measures—length, 1.2 mm.; diameter, 0.3 mm. Two additional specimens from the same locality are in Mrs. Oldroyd's collection.

MELANELLA (BALCIS) CATALINENSIS, new species.

Plate 40, fig. 7.

Shell elongate-conic, slender, doubly flexed, the main flexure being turned to the right, while the extreme tip is slightly bent backward; bluish-white, polished. First two whorls well rounded, separated by a well-constricted suture, the rest moderately rounded on the convex, and slightly so on the concave side of the spire, separated by a scarcely defined suture. The posterior limit of the whorls shines through the substance of the shell and appears as a conspicuous false suture. Periphery of the last whorl slightly angulated. Base moderately produced, well rounded. Aperture oval; posterior angle acute; outer lip produced at the periphery; inner lip somewhat sinuous, very oblique, slightly reflected and appressed to the base; parietal wall covered with a thick callus.

The type (Cat. No. 173802, U.S.N.M.) was dredged in Catalina Channel. It has 10 whorls and measures—length, 5.2 mm.; diameter, 1.6 mm.

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
1	U.S.N.M.	211822	Off Santa Rosa Island, station 2901.	48 fathoms, mud bottom, 55° bottom temperature.
1	Oldroyd		Off San Pedro	Deep water.
1	Cooke		Off Coronado Islands	
1	Kelsey		San Hipolito Point	

MELANELLA (BALCIS) FALCATA Carpenter.

Plate 42, fig. 6.

Eulima falcata CARPENTER, Proc. Zool. Soc., 1865, p. 280.

Shell doubly flexed, the anterior portion being turned to the right and the tip backward, yellowish-white. Early whorls decollated, the succeeding turns slightly rounded, more so on the curved than the concave side of the spire, marked by exceedingly fine lines of growth only, separated by a weakly impressed suture. Periphery of the last whorl subangulated, base moderately produced, well rounded. Aperture ovate; posterior angle acute; outer lip (fractured); inner lip short, curved, reflected over and appressed to the base; parietal wall covered by a moderately thick callus.

Carpenter's type (Cat. No. 123, U.S.N.M.) was collected by Mr. Rowell at Acapulco, Mexico. It has eight whorls remaining and measures—length, 7.6 mm.; diameter, 2.2 mm.

MELANELLA (BALCIS) YOD Carpenter.

Plate 40, fig. 9.

Leiostraca yod CARPENTER, Cat. Maz. Shells, 1857, p. 441.
Melania distorta PHILIPPI, Moll. Sci., vol. 1, p. 158, pl. 9, fig. 10.
Eulima distorta DESHAYES in Lamarck An. s. Vert., vol. 8, p. 454.—PHILIPPI, Moll. Sci., vol. 2, p. 135.—FORBES and HANLEY, Brit. Moll., vol. 3, p. 232.—CLARK, Moll. Test. Mar. Brit., p. 451.
Leiostraca distorta, H. and A. ADAMS, Gen. Rec. Moll., vol. 1, 1854, 236.

"L. t. '*L. distortae*' simillima, sed minima; parte suturali paululum latiore.

"The type of *Leiostraca iota* C. B. Ad. erroneously labeled 'Jamaica' in Mus. Cuming, and very incorrectly figured by Sow. is somewhat broader and less bent than the Mazatlan shells: in other respects it exactly accords. After repeated comparison of very fresh specimens with the British dwarf variety of *L. distorta*, the characters appear exactly alike, except that the sutural portion, which (the shell being transparent) gives an appearance of a spiral line, is slightly narrower in the Scarborough specimens received from Mr. Bean. The same glossy deposit over the base, with the rather separate parietal lip, giving in some directions of light the appearance of an umbilicus, appears in each, and of the same shape. No difference can be traced in the minute vertex, nor in the varices. The colour in fresh specimens exactly accords. The specimens in Mr. Andrew's collection, grouped under *Eu. distorta*, vary extremely in size and arcuation. The Mazatlan shells are on a much smaller scale, generally more bent, and most beautifully glossy and transparent. The same form occurs in the West Indies (B. M.). According to Deshayes (Lam. An. s. Vert., vol. 3, p. 455, No. 8) it is found fossil in Grignon and other places. If it extends so far back in time, it is natural that the living shell should occupy a widely distributed space. As, however, the animals may be distinct, both in this and in *L. iota*, a name is added expressive of its (for the genus) extreme minuteness. The smallest sp. (of 3 normal whorls) measures '035 by '016. A remarkably large sp. measures long. '082, long. spir. '055, lat. '033, div. 18°.

"*Hab.*—Norway to Mediterranean, Forbes; W. Indies, B. M.

"(Var. *Yod.*) Mazatlan; 34 sp. living on *Spondylus*, dead on *Chama;* L'pool Col.

"Tablet 2027 contains 4 sp. of different ages. The largest possesses its operculum, which appears like that of *Chrysallida*, but with the rugae much coarser. Another is broken so as to show the axis of the upper whorls."

We have not seen specimens of this minute, curved species and have copied Carpenter's description and figure; the latter is a camera lucida sketch.

STROMBIFORMIS (BALCIS) BIPARTITA Mörch.

Eulima bipartita MÖRCH, Mal. Blät., vol. 6, 1860, pp. 120–121.

"Shell shining, diaphanous, flexed to the right. Whorls 10, flattened, divided by a spiral band a little below the middle; the upper band white, the lower milk-white. Last whorl subangulated at the periphery. Aperture piriform, outer lip arcuate, produced; inner lip straight, with a callus; parietal wall covered with a moderately thick callus, which renders the peritreme complete. A series of impressed varices form an oblique line on the right side. Length, 7.5 mm.; diameter, 2.5 mm. Hab.: Sansonate Mexico. Three specimens with broken apex."

The above is a translation of Mörch's description. I have so far not seen specimens agreeing with it.

MELANELLA (BALCIS) ADAMANTINA de Folin.

Plate 42, fig. 1.

Eulima adamantina DE FOLIN, Les Meleagrinicoles, 1867, p. 62, pl. 6, fig. 2.

"Shell very small, imperforate, elongate, arcuate, acuminate, very highly polished, hyaline. Whorls nine in number, flattened, with a barely perceptible suture. Altitude of body whorl equal to one-third that of the entire shell. Aperture semilunate; margins a little thickened, the left slightly reflexed. Long., 0.0025, diam., 0.0008.

"Nothing is more brilliant than this species of *Eulima*. The outline is very much elongated, although its apex, a little obtuse. The altitude of the shell makes it appear acute. It is crystalline, extremely diaphanous, with a considerable luster. The spire is composed of nine whorls, which at first increase showly. The curvature of the spire is rather pronounced, turning the shell from right to left, so that the right side is concave and the left side convex. The whorls of the spire are united by a simple linear suture, very finely and very clearly traced. The transparency of the shell allows the base of each of the whorls to be seen, and the shell is thickened a little both above and below the suture. The final whorl is equal to about one-third of the total altitude and it is imperforate. The aperture is elongate and semicircular. Its margins are simple and joined very sharp, and the left is slightly reflected and turned back upon the columella.

"*Type locality.*—Negritos, or Margarita Island, Panama."

I have not seen specimens of this species and quote the description and figure.

MELANELLA (BALCIS) GIBBA de Folin.

Plate 43, fig. 2.

Eulima gibba De Folin, Les Meleagrinicoles, 1867, p. 64, pl. 6, fig. 4.

"Shell imperforate, ventricose, acuminate posteriorly. The apex rather obtuse, crystalline, very highly polished; whorls nine in number, increasing slowly in size, united by a simple suture. The final whorl tumid, more strongly inflated toward the left. Aperture semilunate. Margins simple; columella strongly reflected. Long., 0.003; diam., 0.0013.

"Like the preceding, this species may also be considered remarkable. It is corpulent, rather acuminate, recurved posteriorly, its apex seeming to try to unite with the aperture. It is quite as diaphanous as *adamantina* and as highly polished. The spire is composed of nine whorls. The early whorls increase slowly in diameter, but proportionately they enlarge rather rapidly; the increase takes place especially upon the left side. The final whorl, which alone constitutes one-half of the entire shell, is very much developed on this side. It is inflated and extends considerably beyond the line, which, judging from the margins of the preceding whorls, would serve as contours for it. In order to recognize the aperture when the final whorl has reached its maximum extension, it is necessary that it be oriented toward the right following a very oblique line. These abnormal conditions upon it, and consequently upon the entire shell, cause a hunchbacked outline, which serves as one of the principal diagnostics of this species. The suture is the same as that of *E. adamantina*. The aperture is cordate, elongate; its margins are well joined, and are united by a curve which represents its greatest diameter. The margins are somewhat thickened; the left, especially at the base of the aperture, is reflected, and is expanded over the final whorl in a decurrent angle, and at the same time it is reflected backwards over the columella.

"*Type locality.*—Negritos; or Margarita Island, Panama."

I have not seen specimens of this species and quote the description and figure.

MELANELLA (BALCIS) IOTA C. B. Adams.

Plate 40, fig. 5.

Eulima iota C. B. Adams, Ann. Lyc. Nat. Hist. New York, vol. 5, 1852, p. 422.

Shell very small, doubly flexed, semitranslucent, polished. Early whorls slightly rounded, the later ones flat, scarcely marked by lines of growth. Suture well marked. Periphery of the last whorl obscurely angulated. Base short, well rounded. Aperture moderately large; posterior angle acute; outer lip thin, inner lip fractured (reconstructing from the preceding whorls, we may say that it is concavely curved, reflected over and appressed to the base.)

Two specimens of this species were found at Panama by Prof. C. B. Adams. One of these, the type, is in the collection of Amherst College, Amherst, Massachusetts. This has nine whorls and measures—length, 1.7 mm.; diameter, 0.6 mm.

EULIMOSTRACA, new genus.

Melanellids in which the inner lip is not appressed to the attenuated basal portion of the preceding whorl; whorls almost flattened; outer lip of aperture not expanded; color markings present.

Type.—Eulimostraca galapagensis Bartsch.

EULIMOSTRACA GALAPAGENSIS, new species.

Plate 43, fig. 1.

Shell broadly elongate-conic, thin, translucent, showing the internal structure through the substance of the shell. Whorls rather high between the sutures, moderately well rounded, appressed at the summit; polished, marked by exceedingly fine incremental lines only. Suture lightly impressed. Periphery of the last whorl somewhat inflated; strongly angulated, marked by a narrow brownish band. Base short, well rounded. Aperture very broadly oval; posterior angle acute; outer lip thin, tinged with brown on the posterior half, decidedly protracted in the middle, to form a claw-like element; inner lip strongly curved, slightly reflected, fusing only slightly, posteriorly, with the preceding whorl; parietal wall covered by a thin callus.

The type and seven specimens (Cat. No. 251281, U.S.N.M.) were dredged off Galapagos Island, by the United States Bureau of Fisheries steamer *Albatross*, at station 2813, in 40 fathoms, on coral sand bottom, bottom temperature 80°. The type has 11 whorls and measures—length, 3.8 mm.; diameter, 1.2 mm.

Genus SABINELLA Monterosato.

Sabinella Monterosato, Natur. Sicil., 1890, p. 15. Type, *Sabinella piriformis* Brugnone.

Melanellids in which the inner lip is not appressed to the attenuated basal portion of the preceding whorl; whorls strongly rounded; aperture very large and outer lip decidedly expanded; color markings absent.

SABINELLA CHATHAMENSIS, new species.

Plate 43, fig. 4.

Shell broadly conic, yellowish-white, polished, marked by exceedingly fine protractive lines of growth only. The first two whorls well rounded, separated by a well-impressed suture, succeeding ones moderately rounded. Aperture very large, somewhat channeled

anteriorly; posterior angle acute; outer lip very strongly protracted between the posterior angle and the base, forming a decidedly claw-like element; inner lip decidedly curved, revolute with the posterior half appressed to the base; parietal wall covered with a thin callus.

The type (Cat. No. 251283, U.S.N.M.) was dredged by the United States Bureau of Fisheries steamer *Albatross* at station 2808, off the Galapagos Islands, in 634 fathoms, on coral sand bottom, bottom temperature 40°. It has nine whorls and measures--length, 3 8 mm., diameter, 1.3 mm.

SABINELLA BAKERI, new species.

Plate 43, fig. 5.

Shell small, very broadly conic, creamy-white. All the whorls moderately rounded, excepting the last which is very strongly rounded. All marked by rather prominent lines of growth, and rather numerous irregularly disposed varices, of which there are sometimes several to a single whorl. Suture moderately constricted. Periphery of the last whorl inflated, strongly rounded. Base short, strongly rounded, marked like the spire. Aperture very large; posterior angle acute; outer lip thin at the edge, decidedly produced, and protracted in the middle to form a strong claw-like element; inner lip slender, slightly curved, somewhat revolute, free for its entire length; parietal wall glazed by a thin callus.

The unique type (Cat. No. 215786, U.S.N.M.) was collected by Dr. Fred Baker, at San Diego, California. It has nine whorls and measures—length, 2.7 mm.; diameter, 1.1 mm.

SABINELLA OPALINA de Folin.

Plate 43, fig. 7.

Eulima opalina De Folin, Les Meleagrinicoles, 1867, pp. 67, 68, pl. 6, fig. 7.

"Shell imperforate, rather elongate, opaque, shining, opaline, darkly spotted with red. Spire conic, attenuated, tapering to a subacute apex. Whorls, 10 in number, increasing slowly in diameter, united by a simple suture, final whorl equal to one-third the altitude of the entire shell, strongly depressed at the base. Aperture subquadrate, the margin slightly thickened, columella reflected. Long., 0.0035; diam., 0.0018.

"This, again, is one of the prettiest of the species. It is red, elongated, but less so than those which precede it, and for this reason its diameter is relatively greater.

"It is conspicuously conic, and for this reason appears less acuminate, although its apex is acute. The spire is made up of 10 whorls, which increase slowly in diameter, but which increase more rapidly in diameter than in altitude. The final whorl, which is almost one-third as long as the entire shell, is imperforate, and very much depressed

at the base. A simple suture, similar to that of the preceding species, unites these 10 whorls. The aperture is subquadrate, acute at the point of union of the right margin with that of the final whorl. The right margin is simple, very slightly thickened. It is feebly reflected and merges smoothly into the left margin, which, with the increasing reflection of the margin, is spread out over the final whorl, and the columella. This species is almost opaque, colored in an opaline shade, which is very pronounced on the final whorls. On the medial portion of the shell the carmine tints of the spire are lost in the background.

"*Type locality.*—Negritos; or Margarita Island, Panama."

I have not seen specimens of this species and quote the description and figure.

SABINELLA? PTILOCRINICOLA Bartsch.

Plate 44, fig. 2.

Eulima ptilocrinicola BARTSCH, Proc. U. S. Nat. Museum, vol. 32, 1907, pp. 555–556, pl. 53.

Shell elongate-conic, thin, polished, transparent, tinged with bluish-white (the dried animal showing through the upper whorls as a granular golden-yellow mass.) Whorls 11, increasing regularly in size, decidedly rounded, with the surface weakly malleated, having a few feebly developed varices which appear at irregular intervals as narrow opaque vertical bands. Summit of the whorls closely appressed to the preceding turn, the extreme edge forming a slender spiral sutural band. Last whorl quite strongly inflated basally. Periphery and base well rounded, marked like the spire. Aperture moderately large, suboval; outer lip thin, evenly curved; inner lip slender, vertical, slightly reflected; parietal wall covered by a thin callus. Operculum thin, corneous.

The type (Cat. No. 195373, U.S.N.M.) was dredged by the United States Bureau of Fisheries steamer *Albatross* at station 3342, in 1,588 fathoms, off British Columbia, and measures—length, 9.5 mm.; diameter, 3.9 mm.

SABINELLA MERIDIONALIS, new species.

Plate 43, fig. 3.

Shell small, bluish-white, polished, marked by exceedingly fine lines of growth only. Early whorls decollated, later ones well rounded, separated by a moderately compressed suture. Periphery of the last whorl well rounded; base moderately long, well rounded. Aperture very broadly oval; posterior angle acute; outer lip thin, decidedly protracted in the middle between the posterior angle and the base; inner lip slender, curved, reflected over and partly appressed to the base posteriorly; parietal wall covered by a thin callus.

The type (Cat. No. 251282, U.S.N.M.) was dredged by the United States Bureau of Fisheries steamer *Albatross* at station 2808 off the Galapagos Islands, in 634 fathoms, on coral sand bottom, bottom temperature 40°. The last five whorls only remain in our specimen, but they are so distinct from any other that the species will readily be recognized by them. These measure—length, 3.9 mm.; diameter, 1.3 mm.

Genus HALIELLA Monterosato.

Haliella Monterosato, Enum. & Syn., 1873, p. 35, Type, *Haliella stenostoma* (Jeffreys).

Melanellids in which the inner lip is provided with a twist which gives it the appearance of having an obsolete fold.

HALIELLA ABYSSICOLA, new species.

Plate 43, fig. 8.

Shell elongate-conic, straight, semitransparent, polished, bluish-white, marked by scarcely perceptible lines of growth. Whorls slightly rounded, rather high between the sutures; the appressed portion of the summit appearing as a narrow white band, the posterior limit of which forming the suture is scarcely perceptible since it practically fuses with the preceding turn. Periphery of the last whorl well rounded. Base moderately long, well rounded. Aperture very large, ear-shaped; posterior angle acute; outer lip very thin, becoming gradually protracted from the posterior angle to the periphery, then more rapidly retractive toward the base, basal portion of the outer lip forming a broad, rounded channel; inner lip long, decidedly sigmoid, slightly reflected and partly appressed to the base, provided with a twist a little anterior to its insertion; parietal wall covered with a thin callus.

The type (Cat. No. 251266 U.S.N.M.) was dredged by the United States Bureau of Fisheries steamer *Albatross* at station 2923, off Southern California, in 822 fathoms, on green mud bottom, bottom temperature 39°. It has 10 whorls and measures—length, 10.4 mm.; diameter, 2.9 mm. Cat. No. 251265 U.S.N.M. was also collected by the *Albatross* at station 4368, off Point Loma Light, California, in 215 to 240 fathoms, on green mud. Cat. No. 266887 U.S.N.M. contains still another specimen of this species dredged off San Pablo Point, Mexico, by the *Albatross* at station 5675, in 284 fathoms, on green mud and fine sand bottom, bottom temperature 44.8°

HALIELLA CHILENSIS, new species.

Plate 43, fig. 6.

Shell elongate-conic, slender, semitranslucent to bluish-white, polished, surface marked by exceedingly fine lines of growth only. Whorls almost flattened, separated by a scarcely defined suture. Periphery of the last whorl well rounded. Base moderately long, well rounded. Aperture ovate; posterior angle acute; outer lip mod-

erately protracted between the posterior angle and the base; inner lip slender, curved, partly reflected over and appressed to the base posteriorly; parietal wall covered with a thin callus.

The type and four specimens (Cat. No. 251284, U.S.N.M.) were dredged by the United States Bureau of Fisheries steamer *Albatross* at station 2784, off Chile, in 194 fathoms on blue mud bottom, bottom temperature 51.9°. The type has nine whorls and measures—length, 5.5 mm.; diameter, 1.3 mm.

HALIELLA LOMANA Dall.

Plate 44, fig. 1.

Eulima (?) *lomana* DALL, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 253.

Shell very large, regularly elongate-conic, creamy white. The early whorls decollated. The succeeding turns slightly rounded, very narrowly and feebly shouldered at the summit, marked by faint, retractive, incremental lines, and numerous very regularly incised equal and closely-spaced spiral striations. Suture moderately impressed. Periphery of the last whorl angulated. Base moderately long, well rounded, marked like the spire. Aperture large, broadly oval, outer lip thin, fractured at the edge; inner lip rendered slightly sinuous by a twist a little anterior to its insertion; somewhat revolute, entirely free from the base; parietal wall covered by a thin callus.

The type and another specimen of this species (Cat. No. 110652, U.S.N.M.) were dredged by the United States Bureau of Fisheries steamer *Albatross* at station 4354, 16 miles off Point Loma Light, California, in 642 to 650 fathoms, on gray mud bottom, bottom temperature 38.5° to 39°. The type has nine whorls remaining and measures—length, 20.2 mm.; diameter, 7 mm.

Genus SCALENOSTOMA Deshayes.

Scalenostoma DESHAYES, Cat. Moll. Ile de la Reunion, 1863, pp. 58–60, pl. 7, figs. 26–8, Type *Scalenostoma carinatum* Deshayes=*Subeulima* Souverbie Journ. de Conch., vol. 23, 1875, p. 296, Type *Subeulima lamberti* Souverbie.= *Amblyspira* Dall, Proc. U. S. Nat. Mus., vol. 19, 1896, p. 314, Type *Aclis*? (*Amblyspira*) *teres* Guppy.

Melanellids having an acute keel at the periphery of the whorls, which gives to the outer lip of the aperture a }-shaped appearance.

SCALENOSTOMA RANGII De Folin.

Plate 45, fig. 4.

Chemnitzia rangii DE FOLIN, Les Meleagrinicoles, 1867, pp. 61–62, pl. 6, fig. 1.
Odostomia (*Scalenostoma*) *rangii* DALL and BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, p. 230.
Odostomia (*Scalenostoma*) *rangii* BARTSCH, Proc. U. S. Nat. Mus., vol. 42, 1916, p. 344.

"Shell imperforate, elongate-conic. Apex rather obtuse, light colored. Whorls smooth, 12 in number. The earlier whorls nor-

mal, increasing regularly in diameter; the altitude of the body whorl one-third that of the entire shell. Suture simple above, afterward keeled by the preceding whorl. Aperture quadrate; the margins simple; the left lip somewhat reflected. Alt., 0.0027; diam., 0.0011.

"It is in honor to the memory of the learned Commodore Rang that we have given his name to this odd species of *Chemnitzia* and we feel a considerable satisfaction in being able thus to give witness to our feelings of profound esteem for a leader under whose orders we have served, as well as to express our admiration for his high scholarship. This shell is somewhat elongate, yellowish in color, tending a little toward a brown. The apex is rather obtuse. The spire is made up of 12 whorls, all of them smooth. The sides of the early whorls are almost straight, and this part of the shell is regularly conic. The four or five later whorls differ from the first anteriorly in that they escape from the profile of the cone and widen on a plane with the base, thus forming a prominent keel, which is very thin, almost sharp edged, upon the periphery. This expansion of the base follows the whorls of the spire, increasing in prominence as they increase in diameter. Thus the keel terminates on the right margin of the aperture. The suture is extremely narrow, and on the whorls furnished with the keel which we have just described it occurs in front of the keel, between the keel and the succeeding whorl. The aperture is almost quadrate: the margins are simple, and the left margin is slightly reflected upon the columella.

"*Type locality.*—Negritos, or Margarita Island, Panama."

I have not seen specimens of this species, and quote the description and figure.

SCALENOSTOMA BABYLONIA Bartsch.

Plate 45, fig. 2.

Odostomia (*Scalenostoma*) *babylonia* BARTSCH, Proc. U. S. Nat. Mus., vol. 42, 1912, p. 287, pl. 38, fig. 3.

Shell elongate-conic, light yellowish-brown, excepting the umbilical area, the extreme basal portion, and tip, which are white. Nuclear whorls very small. Postnuclear whorls flattened, separated by a scarcely impressed suture. On the last three turns the whorls are marked at the periphery by an exceedingly strong, acute, spiral keel, which is slightly bent downward. Base of the last whorl short, well rounded. Entire surface of spire and base smooth, except for exceedingly fine, incremental lines. Aperture oval; posterior angle acute; outer lip rendered }-shaped by the spiral keel; inner lip slender, evenly curved, very slightly revolute; parietal wall glazed with a thin callus.

Two specimens of this species (Cat. No. 127542, U.S.N.M.) come from San Hipolito Point, Lower California. The type has 10 post-nuclear whorls and measures—Length, 3 mm.; diameter, 1.2 mm.

STROMBIFORMIS Da Costa.

Strombiformis DA COSTA, Brit. Conch., 1878, p. 107. Type selected by T. Iredale (Proc. Mal. Soc. London, vol. 11, 1915, pp. 293–295) *Strombiformis glaber* Da Costa.

Very attenuated, slender Melanellids, with very narrow elongated aperture, having the inner lip appressed to the attenuated basal portion of the preceding whorls; marked with one or more spiral color bands.

STROMBIFORMIS RIVERSI, new species.

Plate 45, fig. 3.

Shell large, subulate, yellowish-white with a few faint indications of spiral bands. Early whorls decollated in all the specimens seen, those remaining slightly and evenly rounded, appressed at the summit, separated by an ill-defined suture, marked by feeble, somewhat retractive lines of growth and irregularly disposed poorly impressed varicial streaks. Suture slightly constricted. Periphery of the last whorl well rounded. Base long, gently rounded. Aperture very elongate-ovate: posterior angle acute; outer lip thin; inner lip rather long, moderately thick, well rounded, reflected over and appressed to the attenuated base throughout its entire length; parietal wall glazed with a rather thick callus.

The type and seven specimens of this species were collected by Dr. J. J. Rivers, in the upper San Pedro series, at Santa Monica Canyon, California. The type and another specimen are in the collection of the United States National Museum (Cat. No. 251390). The rest are in Doctor Rivers's collection. The type has lost the nuclear whorls. The 10 remaining measure—length, 12 mm.; diameter, 2.5 mm.

This is the largest of the West American members of the genus *Strombiformis* known.

STROMBIFORMIS ALASKENSIS, new species.

Plate 45, fig. 1.

Shell small, straight, yellowish-white, marked by exceedingly fine lines of growth only. Whorls rather high, almost flattened, appressed at the summit, separated by a scarcely impressed suture. Periphery of the last whorl well rounded, base moderately long, moderately rounded. Aperture oval; posterior angle acute; outer lip decidedly protracted between the posterior angle and the base; inner lip moderately stout, curved, reflected over and appressed to the base; parietal wall glazed with a moderately thick callus.

The type (Cat. No. 322301 U.S.N.M.) comes from Dutch Harbor, Unalaska, Alaska. It has seven whorls and measures—Length, 4.2 mm.; diameter, 1.4 mm.

STROMBIFORMIS CALIFORNICA, new species.

Plate 45, fig. 5.

Shell narrowly subulate, polished. Early whorls yellowish-white, succeeding ones light brown, marked with a dark chestnut brown band at the periphery. A second one of equal strength and size is a little anterior to the middle between the summit and the periphery; lip edged with dark brown. Early whorls rounded, separated by impressed sutures, the succeeding turns flattened with scarcely defined suture, marked by exceedingly fine lines of growth and slightly retractive, irregularly disposed pale brown varicial streaks. Periphery of the last whorl well rounded. Base produced, well rounded. Aperture elongate, oval; posterior angle acute, slightly effuse anteriorly; outer lip thin, inner lip long, curved, revolute appressed to the base, except at the very tip, where it is free; parietal wall covered with a moderately thick callus.

The type and six specimens (Cat. No. 249619, U.S.N.M.) were dredged in San Diego Bay. The type has 13 whorls and measures—Length, 11.5 mm.; diameter, 2.1 mm. This species resembles *Strombiformis townsendi* from the Gulf of California, but differs from it in being uniformly more slender, and also in the color markings.

The following additional specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
2	U.S.N.M.	203667	Off San Diego	20 fathoms.
1	Oldroyd		do	14 fathoms dredged by Mr. Gripp.
1[1]	Kelsey		do	60 fathoms.
1	U.S.N.M.	251392	Off Catalina Island	50 fathoms.
1	Lowe	3501	Catalina Island	

[1] Fragment.

STROMBIFORMIS TOWNSENDI, new species.

Plate 46, fig. 4.

Shell subulate, polished, tip white, the rest flesh colored with a broad pale zone of brown near the summit, in the middle of which is a darker line. A second pale zone of brown surrounds the middle of the whorl and is separated from the one of the summit by a clear flesh-colored band, which is about as wide as the band, separating it from a third brown zone at the periphery. This third zone extends about as far below the periphery of the last whorl as it extends above it, and is edged on both sides by a very dark, translucent brown band. The middle of the base is surrounded by another brown band, and the

lip is edged with pale brown. Early whorls moderately well rounded, separated by a well-impressed suture; succeeding turns flattened and separated by a scarcely defined suture. Surface marked by exceedingly fine retractive lines of growth and an occasional narrow varicial streak. Periphery of the last whorl well rounded. Base somewhat produced, well rounded. Aperture elongate ovate; posterior angle acute; outer lip thin; inner lip strong, curved, reflected over and appressed to the base throughout its entire length; parietal wall glazed with a thick callus.

The type and three specimens (Cat. No. 251391, U.S.N.M.) were dredged by the United States Bureau of Fisheries steamer *Albatross* at station 2822 off La Paz, Gulf of California, in 21 fathoms on gray sand and broken shell bottom. The type has 13 whorls and measures—length, 11 mm.; diameter, 2.5 mm.

The following additional specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
6	U.S.N.M.	268591	South end of Angel de la Guardia Island, Gulf of California.	Shallow water; dredged by the author.
3	do	266359	Agua Verde Bay, Gulf of California.	2 fathoms; dredged by the author.
1	do	268592	Gulf of California	
1	Cooke		do	

STROMBIFORMIS LAPAZANA, new species.

Plate 46, fig. 3.

Shell narrowly subulate, polished, tip yellowish-white, the rest flesh-colored with a broad translucent zone of light brown, which is edged on either side by a narrow vary dark band, the anterior one of which marks the periphery, while the posterior falls a little anterior to the middle of the space between the summit and the suture. Early whorls rounded, separated by a well-marked suture, all the rest flattened, marked by feeble lines of growth and an occasional pale brown retractive varicial streak. Suture poorly defined. Periphery of the last whorl well rounded. Base produced, well rounded. Aperture elongate-ovate, slightly effuse anteriorly; posterior angle acute; inner lip short, curved, revolute, reflected over, and appressed to the base; parietal wall covered with a moderately thick callus.

The type and 43 specimens (Cat. No. 211388, U.S.N.M.) were dredged by the United States Bureau of Fisheries steamer *Albatross* at station 2823, in 26½ fathoms off La Paz, Gulf of California, on broken shell bottom. The type has 13 whorls and measures—length, 7.8 mm.; diameter, 1.3 mm.

The following additional specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
3	U.S.N.M.	96715	Off La Paz, Gulf of California, U. S. B. F. station 2823.	26½ fathoms, broken shell bottom.
11	do	211670	Off La Paz, Gulf of California, U. S. B. F. station 2822.	21 fathoms on gray sand and broken shell bottom.
5	do	251394	Off Ceralvo Island, Gulf of California, U. S. B. F. station 2826–2828.	9½–10 fathoms, shell bottom, 74° bottom temperature.
1	do	251393	Agua Verde Bay, Gulf of California.	

STROMBIFORMIS ALMO, new species.

Plate 46, fig. 5.

Shell broadly elongate-conic, polished, bluish-white, excepting a broad band of light chestnut brown, which encircles the turns covering a little more than half the spaces between the periphery and the summit and extending for an equal distance over the base. Early whorls rounded, separated by a well-impressed suture; the succeeding turns moderately rounded, with very poorly impressed suture, marked by faint lines of growth and an occasional almost vertical varicial line, which is not accompanied by any brown marking. Periphery of the last whorl well rounded. Base produced, well rounded. Aperture broadly ovate, somewhat patulose anteriorly; posterior angle acute; outer lip thin; inner lip short, moderately stout, curved, reflected over, and appressed to the base, except at the extreme tip, where it is free; parietal wall covered with a thick callus.

The type and two specimens (Cat. No. 251395, U.S.N.M.) were dredged by the United States Bureau of Fisheries steamer *Albatross* at station 2902, in 53 fathoms off Santa Rosa Island, California, on fine gray sand and mud bottom, bottom temperature 45°. The type has 10 whorls and measures—length, 7 mm.; diameter, 1.8 mm.

The following additional specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
2	Oldroyd		Off San Pedro	Deep water.
3	do		Off San Pedro, Cal.; dredged by University of California.	
1	U.S.N.M.	251396	Off Point Loma Light, Cal.; dredged by U. S. B. F. steamer *Albatross*, station 4348.	59–113 fathoms; fine gray sand and broken shell and mud bottom.
1	Baker		Off San Diego	60 fathoms.
1	Button		San Diego	

STROMBIFORMIS FUSCOSTRIGATA Carpenter.

Plate 46, fig. 1.

Eulima fuscostrigata CARPENTER, Ann. Mag. Nat. Hist., ser. 3, vol. 14, 1864, p. 47.

Shell broadly conic, polished, tip brown; the anterior third between the sutures of each turn and the base of the last turn, dark brown. On the last half of the last turn the brown of the basal portion splits into two bands, one a little below the periphery and the other marking the extremity. Early whorls strongly rounded, separated by a well impressed suture, the succeeding ones almost flat with an ill-defined suture. Surface marked by fine lines of growth only. Periphery of the last whorl weakly angulated. Base somewhat produced, moderately rounded. Aperture ovate; posterior angle acute; outer lip thin; inner lip moderately long, rather stout, curved, revolute, and appressed to the base; parietal wall covered by a moderately thick callus.

Carpenter's type (Cat. No. 4105, U.S.N.M.) comes from Cape San Lucas, Lower California. It has 10 whorls and measures—length, 4.7 mm.; diameter, 1.3 mm.

STROMBIFORMIS PANAMENSIS, new species.

Plate 46, fig. 2.

Shell elongate-conic, bluish-white, polished, with a narrow pale-brown band marking the appressed summit of the whorls; half of the space between this dark band and the suture is white; the rest of the whorl is suffused with pale brown; the aperture, too, is edged with pale brown, while the extremity of the base is white. Early whorls slightly rounded, separated by an impressed suture, the succeeding turns almost flattened, marked by exceedingly fine lines of growth and an occasional retractive varicial line which is not accompanied with any color markings. The appressed portion of the whorls is dark in color and the anterior limit of the appressed portion appears as a false suture, the true suture being very inconspicuous. Periphery of the last whorl well rounded. Base produced, well rounded. Aperture elongate-ovate, slightly effuse anteriorly; posterior angle acute; outer lip thin; inner lip moderately long, curved, reflected and appressed to the base for its entire length; parietal wall covered with a moderately thick callus.

The type (Cat. No. 215787, U.S.N.M.) was dredged by the United States Bureau of Fisheries steamer *Albatross* at station 2799 in 29½ fathoms, in Panama Bay, on green mud bottom. It has 11 whorls and measures—length, 6 mm.; diameter, 1.3 mm.

STROMBIFORMIS BARTHELOWI, new species.

Plate 47, fig. 7.

Shell polished, acicular, uniformly pale brown. Early whorls well rounded, separated by a constricted suture; the succeeding turns flat, with a less conspicuous suture, marked by very fine vertical lines of growth only. Periphery of the last whorl well rounded. Base rather long, evenly rounded. Aperture very elongate-ovate; posterior angle acute; outer lip thin, not protrated in the middle; inner lip slender, slightly curved, reflected over and appressed to the base throughout its entire length; parietal wall glazed with a thin callus.

The type (Cat. No. 268622, U.S.N.M.) was collected by the author in Santa Maria Bay, Lower California. It has eleven whorls and measures—length, 5 mm.; diameter, 1.3 mm. Cat. No. 267746, U.S.N.M., contains another specimen dredged by the author in shallow water in the same place.

STROMBIFORMIS HEMPHILLI, new species.

Plate 47, fig. 4.

Shell polished, the three or four early whorls increasing slowly in size, the rest more rapidly, which lends the outline of the spire a somewhat constricted appearance near the summit. Early whorls well rounded, with moderately impressed suture. The whorls are marked with irregular, triangularly shaped streaks of brown, which are broadest at the varicial streaks and taper backward to a point, one side following the summit. Base marked by an interrupted brown band, situated a little anterior to the periphery, and the second, slightly narrower, about one-third the distance between the peripheral band and tip of the base, anterior to the peripheral band. The extreme tip of the inner lip is brown. Early whorls moderately rounded, separated by an impressed suture, the later ones very slightly rounded, separated by an inconspicuous suture, marked by exceedingly fine lines of growth and occasional varicial streaks. Periphery of the last whorl feebly rounded. Base moderately long, well rounded. Aperture rather small, ovate; posterior angle acute; outer lip thin; inner lip very oblique, somewhat sinuous, slightly reflected with posterior portion appressed to the base; parietal wall covered by a thick callus.

The type and three specimens of this species (Cat. No. 127554, U.S.N.M.) were collected by Mr. Henry Hemphill in shell drift, at Point Abreojos, Lower California. The type has 9 whorls and measures—length, 3.1 mm.; diameter, 1.1 mm.

I have seen the following additional specimens:

Number of specimens.	Collection of—	Catalogue number.	Locality.
26	Oldroyd		Point Abreojos, Lower California.
2	Button		Do.
1	Johnston		Do.
7	U.S.N.M.	215788	San Hipolito Point, Lower California.
6	Oldroyd		Point Abreojos, Lower California.

STROMBIFORMIS BURRAGEI, new species.

Plate 47, fig. 5.

Shell very small, elongate-conic, polished, light yellow, with the tip light brown and with a broad brown band on the middle of the base. Early whorls well rounded, separated by a constricted suture. The succeeding turns weakly rounded, with a very feebly impressed suture, marked by exceedingly fine lines of growth only. Periphery obscurely angulated. Base rather short, well rounded. Aperture broadly oval; posterior angle obtuse; outer lip thin; inner lip short, decidedly curved, reflected and appressed to the base posteriorly; parietal wall covered by a thick callus.

The type (Cat. No. 267582, U.S.N.M.) was dredged in 3 fathoms at the head of Concepcion Bay, Gulf of California, by the United States Bureau of Fisheries steamer *Albatross* on mud bottom. It has lost the first turn; the eight remaining measure—length, 2.7 mm.; diameter, 0.9 mm.

The following additional specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
1	U.S.N.M.	264643	Head of Concepcion Bay	Dredged by U. S. B. F. steamer *Albatross*, 3 fathoms, mud bottom.
1	do	267812	Pichilinque Bay, Gulf of California.	Dredged by the author in shallow water.

STROMBIFORMIS VARIANS Sowerby.

Plate 47, figs. 6, 8.

Eulima varians SOWERBY, Proc. Zool. Soc. London, 1834, p. 8.
Leiostraca varians SOWERBY, Thes. Conch., 1854, p. 804, pl. 170, figs. 23, 24.

"Subfusiform, acuminated, thin, color various; aperture oblong. Some varieties are white, others brown, and others are marked with brown lines and are mottled.

"Xipixapi, Meridional America. (Mus. Cuming.)

"Collected in sandy mud."

I have not seen specimens of this species and copy Sowerby's description and figure.

STROMBIFORMIS PROCA de Folin.

Plate 47, fig. 1.

Eulima proca De Folin, Les Meleagrinicoles, 1867, pp. 62, 63, pl. 6, fig. 3.

"Shell imperforate, elongate, acuminate, thin, shining, milky-white above, pinkish below, and spotted along the sutures with triangular reddish dots. Whorls 10 to 11; the early ones very narrow, the later wider and more convex. The body whorl approximately equal to one-third the altitude of the entire shell. Aperture cordate; the margin slightly thickened, the left margin strongly reflected. Long., 0.0033; diam., 0.001.

"This second species of *Eulima* is also very pretty and very remarkable. The outlines elongated; the whorls of the spire very acuminate. The later whorls, on the contrary, are somewhat wide and somewhat convex. The sides of the whorls, instead of being simply straight, or describing, as is ordinarily the case, take on, in this species, a double curve. The contour is at first concave, then it becomes convex. In consequence of this difference in the margins of the whorls of the spire, the resulting outline is very peculiar, and is a very striking diagnostic. The apex is slightly obtuse; the whorls of the spire are 10 or 11 in number. They increase slowly at first, and without perceptible enlargement, which gives to the early part of the shell, including the five or six whorls, a subcylindric aspect. These whorls are slightly rounded and are united by a rather deeply impressed suture. Near the eighth whorl the diameter increases, and the suture is fainter and becomes nothing more than a simple, very feebly impressed line. The final whorl is equal to about one-third of the total altitude, and is imperforate. The aperture is cordate, and its margins are somewhat thickened. The left margin is reflected, and they are colored a flaming scarlet. The early whorls, milk-white in color, are well flattened between the sutures and the margins; the later whorls are flesh-colored, or tinged with a clear orange. A few elongated, triangular spots, rather regular, and brilliantly colored in flaming scarlet, are disposed along the sutures, and extend for a short distance in front of it. This peculiar ornamentation adds a stamp of originality to this *Eulima*.

"*Type locality.*—Negritos; or Margarita Island, Panama."

I have not seen specimens of this species and quote the description and figure.

STROMBIFORMIS ELEGANTISSIMA de Folin.

Plate 47, fig. 3.

Eulima elegantissima De Folin, Les Meleagrinicoles, 1867, p. 65, pl. 6, fig. 5.

"Shell imperforate, oblong, very highly polished, pellucid, ornamented with two oblique bands, alternated yellow and spotted.

Spire acuminate. Apex rather obtuse. Whorls 10, slowly increasing in size, flattened; the final whorl large, its altitude half of that of the entire shell. Suture simple. Aperture elongate, pyriform, the margins thickened, yellowish; the left margin strongly reflected at the base. Long., 0.005; diam., 0.0015.

"This small shell is very remarkable by reason of its elements; elongated, acuminated outline. The spire is made up of six whorls, which increase slowly in diameter, and which are joined together by a very simple suture. The sides of these whorls are straight, smooth, without convexity, and the suture appears only as a feeble line, revolving about the shell, so that the shell does not seem to be interrupted at the suture line. The final whorl occupies approximately half of the entire altitude and is imperforate, despite the fact that a slight elongated depression, covered in part by the reflected left margin of the aperture, seems to form a convexity which at first sight simulates a perforation. The acuminate outline of the entire shell attenuates slightly the half acute, half obtuse outline of the apex so that it may be considered as acute. The aperture is entirely elongate, pyriform, the two margins colored a dark brown, rounding smoothly into each other. The left is reflected upon the columella, and spreads out over the base of the last whorl. It is not only the exceedingly graceful outline of *Eulima elegantissima* which makes this shell remarkable, it is also the exceedingly high luster with which it shines, and its transparency, equal to that of pure crystal. The luster is due to its perfect polish and also to its clearness. Each of the whorls is ornamented with two yellow ribbons which follow the spire. The color is rather deep along the middle of each ribbon. It lightens toward the margins and almost merges into the crystalline background. It is the same with the elongate spots, which, bending obliquely toward the left bind the ribbons to one another. The total of these characteristics give to *Eulima elegantissima* an aspect like that of marble. The shell near the suture seems to be thicker than away from it. Along the last whorls especially it seems as if there were a little ribbon almost opaque, which makes the shell at this point seem whiter.

"*Type locality.*—Negritos; or Margarita Island, Panama."

I have not seen specimens of this species and quote the description and figure.

STROMBIFORMIS ACUTA Sowerby.

Plate 47, fig. 2.

Eulima acuta SOWERBY, Proc. Zool. Soc. London, 1834, p. 8.
Leiostraca acuta SOWERBY, Thes. Conch., 1854, p. 803, pl. 170, fig. 11.

"Acutely turreted, white; whorls 12, smooth, sutures obsolete, varices few.

"Bay of Montiji, Central America. (Mus. Cuming.)

"Found in coarse sand at a depth of 13 fathoms."

I have not seen specimens of this species and copy Sowerby's description and figure.

Genus NISO Risso.

Niso Risso, Hist. Nat. Eur. Merid., vol. 4, 1826, p. 218, p. 7, fig. 98; type *Niso eburnea* Risso=*Bonellia* Deshayes, Lamarck's Anim. sans. Vert., vol. 8, 1838, p. 286; Type *Bonellia terebellata* Deshayes (=*Bulimus terebellatus* Lamarck)= *Janella* Grateloup, Conch. Foss. Adaur., 1838, p. 12; Type *Bulimus terebellatus* Lamarck= *Volusia* A. Adams, Ann. Mag. Nat. Hist., ser. 3, vol. 8, 1861, p. 306; Type *Volusia imbricata* Sowerby.

Melanellids having the base broadly umbilicated.

NISO SPLENDIDULA Sowerby.

Plate 48, fig. 5.

Eulima splendidula Sowerby, Proc. Zool. Soc., 1834, p. 6, = *Niso splendidula* Sowerby, Thes. Conch., 1854, p. 801, pl. 170, fig. 8.

This species is described by Sowerby as acuminately pyramidal, brownish, articulated near the sutures with white and chestnut; umbilicus large. Aperture anteriorly angulated.

Sowerby's specimen was collected by Cummings at Santa Elena, Ecuador, on sandy mud in 6 to 8 fathoms. The type, figured by Sowerby, has 18 whorls and measures—length, 38 mm.; diameter, 17 mm. It is the largest known from the west coast of America to date.

Cat. No. 251334, U.S.N.M., contains a very badly worn and fragmentary specimens of this species, which was dredged by the U. S. Bureau of Fisheries steamer *Albatross* in the Bay of Panama at station 2798, in 18 fathoms on gray sand and broken shell bottom.

NISO EXCOLPA, new species.

Plate 48, fig. 4.

Shell broadly elongate-conic, widely and openly umbilicated, flesh-colored, with irregularly interrupted axial bands of brown immediately behind the varices, and faint spiral bands. The junction of these produce the intensified color markings, and the lighter areas between hem give the axial markings the interrupted aspect. Umbilicus purple, extreme tip of the shell white. Early whorls well rounded, the later ones flattened, marked by strong lines of growth only. The appressed summit of the whorls falls a little anteriorly to the periphery, and causes the preceding whorl to have an over-hanging appearance. Periphery of the last whorl strongly angulated. Base moderately long, well rounded; umbilicus about one-sixth of the greater diameter of the shell. Aperture rhomboidal, decidedly angulated at the junction of the inner and basal lip, somewhat less so, at the junction of the basal and outer lip; posterior angle

acute; inner lip strongly curved and moderately reflected; parietal wall glazed by a thin callus.

The type and 31 specimens (Cat. No. 267652, U.S.N.M.) were dredged by the U. S. Bureau of Fisheries steamer *Albatross*, in 3 fathoms, in the head of Concepcion Bay, Gulf of California. The type has lost the first whorl; the 14 remaining measure—length, 17.5 mm.; diameter, 6.5 mm.

The following specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.	Remarks.
17	U.S.N.M.	268590	South end of Angel de la Guardia Island, Gulf of California.	Shallow water.
3	do	251335	Off Ceralvo Island, Gulf of California U. S. B. F. stations 2826 to 2828, dredged by steamer *Albatross*.	9½ to 10 fathoms, shell bottom.
39	do	268073	Head of Concepcion Bay	Shallow water.
29	do	268158	Ricason Island, Concepcion Sound, Gulf of California.	Do.
1	do	106980	Espirito Santo Bay, Gulf of California, collected by W. B. Bryant.	
1	do	211389	Off La Paz, Gulf of California, U. S. B. F. station 2823, dredged by steamer *Albatross*.	26½ fathoms, broken shell bottom.
78	do	267543	Head of Concepcion Bay, Gulf of California, dredged by U. S. B. F. steamer *Albatross*.	3 fathoms, mud bottom.
1	do	46511	Mulege Bay, Gulf of California.	
1	do	46508	Gulf of California	

NISO INTERRUPTA Sowerby.

Plate 48, figs. 1, 3.

Eulima interrupta SOWERBY, Proc. Zool. Soc. London, 1834, p. 7 = *Niso interrupta* SOWERBY, Thes. Conch., 1854, p. 801, pl. 170, fig. 9.

Shell broadly elongate-conic, deeply and widely umbilicated, bluish-white, polished, marked with irregularly disposed varicial streaks of rust brown. Early whorls well rounded, later ones less rounded and slightly excurved at the appressed summit, marked by numerous lines of growth and exceedingly fine microscopic spiral striations. Summit of the whorls appressed, falling a little below the angulated periphery of the preceding whorl, thus causing the preceding whorl to appear as slightly overhanging the suture. Periphery of the last whorl angulated. Base short, well rounded, marked like the spire; umbilicus equal to about one-fifth of the greater diameter of the shell. Aperture oval, drawn out into an acute angle at the junction of the inner lip and basal lip; posterior angle acute; outer lip thin; inner lip strongly curved and slightly revolute; parietal wall covered by a thin callus.

Two specimens (Cat. No. 122793, U.S.N.M.) were dredged by the United States Bureau of Fisheries steamer *Albatross* at station 2805

in 51½ fathoms, on green mud bottom, in the Bay of Panama. One of these is a fragment containing the perfect tip and 10 whorls; the other is an adult shell having lost the first one and a half turns and having 13 whorls remaining, which measure—length, 10.3 mm.; diameter, 4.3 mm. We have figured the larger of these two. Cat. No. 251336, U.S.N.M., contains three young specimens, dredged by the United States Bureau of Fisheries steamer *Albatross* at station 2799, in 29½ fathoms on green mud, in the Bay of Panama.

Sowerby's type was collected by Cuming, in the Gulf of Nicoya, Costa Rica, in 11 to 13 fathoms, in coarse sand.

NISO LOMANA, new species.

Plate 49, fig. 4.

Shell large, broadly conic, yellowish-white. Early whorls well rounded, later ones flattened, separated by a decidedly channeled suture, narrowly shouldered at the summit and decidedly angulated at the periphery, marked only by feeble axial lines of growth. The summit of succeeding turns falls a little anteriorly to the angulated periphery and forms a channeled suture. Aperture of the type fractured.

The type (Cat. No. 251337, U.S.N.M.) was dredged by the United States Bureau of Fisheries at station 4310 in 71 to 75 fathoms, off Point Loma, California, on green mud and fine sand bottom, bottom temperature 49.7°. The type has lost the early whorls and the base. The nine whorls remaining measure—Length, 14.5 mm. The fragment of this large species, constituting the type, is so distinctive that there will be no difficulty in recognizing this species when found perfect. A second specimen (Cat. No. 211847, U.S.N.M.), which we believe to represent the tip of this species, has seven whorls and was dredged by the United States Bureau of Fisheries steamer *Albatross* at station 2901, in 48 fathoms, off Santa Rosa Island, California, on mud bottom, bottom temperature 55°.

NISO HIPOLITENSIS, new species.

Plate 49, fig. 5.

Shell very small, elongate-conic, narrowly umbilicated. Tip yellowish-white, base white with a broad median brown band; anterior half of aperture white. Surface polished, marked by fine lines of growth only. Suture feebly impressed. Periphery of the last whorl angulated. Base short, well rounded. Aperture broadly oval; posterior angle acute; outer lip thin, curved and slightly patulose; inner lip curved and revolute, almost covering the narrow umbilicus.

The type and another specimen (Cat. No. 127544, U.S.N.M.) were collected by Mr. Henry Hemphill in shell washings, at San Hipolito Point, Lower California. The type has 10 whorls and measures—length, 3.1 mm.; diameter, 1.2 mm.

We have seen the following additional specimens.

Number of specimens.	Collection of—	Catalogue number.	Locality.
1	U.S.N.M.		San Diego, California.
1	Oldroyd		Do.
2	Button		San Hipolito Point, Lower California, collected by Mr. Henry Hemphill.
13	Oldroyd		Do.

NISO IMBRICATA Sowerby.

Plate 48, fig. 6.

Eulima imbricata SOWERBY, Proc. Zool. Soc., 1834, p. 7=*Niso imbricata* Sowerby, Thes. Conch., 1854, p. 802, pl. 170, fig. 10.

"Acuminately pyramidal, whitish, longitudinally lineated with light red; whorls angulated below, prominent; umbilicus small; aperture anteriorly angulated.

"Sancta Elena; in sandy mud, from 6 to 8 fathoms. (Mus. Cuming.)"

I have not seen specimens of this species and quote the description and figure from Sowerby.

The type figured by Sowerby, in the Thesaurus, has 13 whorls and measures—length, 21 mm.; diameter, 7.7m.

NISO (?) ANTISELLI Anderson and Martin.

Plate 48, fig. 2.

Niso (?) *antiselli* ANDERSON and MARTIN, Proc. Cala. Acad. Sci., vol. 4, ser. 4, 1914, p. 65, pl. 7, fig. 22.

"Shell small, smooth, with six whorls; spire conical, upper whorls absent in the type-specimen; whorls nearly flat, tapering toward the apex, unsculptured; suture appressed; body-whorl sharply angulated at the periphery; base convex, with a distinct umbilicus; aperture quadrate; outer lip distinctly angulated, angle about 100°; inner lip thin, smooth; umbilical opening large but not extending to the apex of the shell.

"*Dimensions.*—Altitude, apex broken, 7.5 mm.; latitude of the last whorl, 4 mm.

"*Occurrence.*—The type-specimen was obtained from the lower Miocene of eastern San Luis Obispo County, California, locality 125.

"The living species of this genus are found in tropical and temperate seas. The placing of this species in the genus *Niso* is somewhat doubtful. The umbilical opening does not extend to the apex of the shell; it is, however, much more pronounced than in any of the Eulimidae or Pyramidellidae and has therefore been classed as a *Niso*.

"*Type.*—No. 135, Cal. Acad. Sci., on top of a hill in the southwest corner of the S. E. ¼ of sec. 29, T. 28, S., R. 15 E., San Luis Obispo County, California.

"Named in honor of Dr. Thomas Antisell, one of the early geologists of California."

I have not seen a specimen of this species and quote the published text and figure.

Genus STILIFER Broderip.

Stilifer BRODERIP, Proc. Zool. Soc. London, 1832, p. 60. Type *Stilifer astericola* Broderip.

Melanellids with a mucronate apex, globular form, and the inner lip not appressed or adnate to the attenuated base of the preceding whorl.

STILIFER ASTERICOLA Broderip.

Plate 49, fig. 2.

Stilifer astericolus BRODERIP, Proc. Zool. Soc. London, 1832, p. 60.

Shell large, globose, with a slender acuminate mucro, which is usually decollated; thin, semitransparent, bluish-white. Postnuclear whorls strongly inflated, marked by strong incremental lines which are almost threadlike and irregularly disposed. The appressed portion of the whorls appears as a bluish band. Body whorl slightly flattened in the middle. Periphery well rounded. Base short, strongly rounded, marked like the spire. Aperture large; posterior angle acute; outer lip very thin, strongly curved, and strongly protracted in the middle to form a clawlike element; inner lip slender, strongly curved; parietal wall covered by a scarcely perceptible callus. Radula absent.

I have seen 16 specimens collected in the water-vascular system of starfish by the California Academy of Science Galapagos Expedition at Tagus Cove, Albermarle, Galapagos. Two of these are Cat. No. 322286 U.S.N.M. One of these, the specimen figured, has $5\frac{1}{2}$ whorls and measures—length, 8.6 mm.; diameter, 6.3 mm.

Broderip's specimens were collected by Hugh Cuming at Hood Island, Galapagos, and I find the following interesting remarks on them in the publication cited:

"The arrival in this country of the shell above recorded, with the soft parts, has afforded data for a generic character indicating a distinct family among the *Pectinibranchiata*, the form and disposition of whose mantle differs from that of any other genus in the order. This mantle (which in *Stil. Astericola* is of a green hue) is thick, fleshy, and cup-shaped, with a small aperture at its base and a free posterior margin enveloping the soft parts and the last whorls of the shell, which has thus somewhat the appearance of a small acorn set in its cup. On the ventral aspect of this mantle is the rudiment of a foot; and from the small basal aperture a retractile *proboscis* (which when exserted is as long as the whole animal) is protruded. At the base of this *proboscis* are two thick, round, somewhat pointed *tentacula;* and at the base of them are the eyes or rather ocular specks without pedicles. The *branchia* is placed on a single stem. At the base of the

proboscis is a spherical muscular stomach, and the intestine ascends into the spire of the shell, where it becomes attached to the liver, which, in the present species, is of an orange colour.

"Mr. Cuming found this elegant parasite burrowed in different parts of the rays of the oral disk of *Asterias solaris*, Gray, where it is almost hidden from sight, so deeply does the animal penetrate into the substance of the *Starfish*, in which it makes a comfortable cyst for itself, wherein it most probably turns by the aid of its rudimentary foot. All the specimens infested with *Stiliferi* appeared to be in the best health, though there is reason to believe that these *Mollusca* feed upon the juices of the *Starfish*. With that instinct of self-preservation imparted to all parasites whose existence depends upon that of their nidus, the *Stilifer*, like the *Ichneumon* among insects, appears to avoid the vital parts; for in no instance did Mr. Cuming find it embedded anywhere save in the rays, though some had penetrated at their base and very near the *pelvis*. When extracted the older shells have much the appearance of a milky, clouded, glass bubble; the younger shells are of an unclouded transparency."

Genus MUCRONALIA A. Adams.

Mucronalia A. ADAMS. Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 301. Type *Mucronalia bicincta* A. Adams.

Melanellids with mucronate apex, cylindric postnuclear spire and with the inner lip not appressed or adnate to the attenuated base of the preceding whorl.

MUCRONALIA? BATHYMETRAE Dall.

Plate 49, fig. 3.

Stilifer (*Mucronalia*) *bathymetrae* DALL, Bull. Mus. Comp. Zool., Cambridge, vol. 43, 1908, No. 6, pp. 317, 318.

"*Mucronalia*? HARTLAUB, Bull. Mus. Comp. Zool., Cambridge, vol. 27, No. 4, 1895, p. 146, pl. 4, fig. 25.

"On a species of *Bathymetra*, dredged by the U. S. S. *Albatross*, at station 3381, off Malpelo Island, Gulf of Panama, in 1,772 fathoms, mud, bottom temperature 37.2° F.

"In Hartlaub's account of the crinoids of the *Albatross* above cited, he mentions and figures a species, referred by E. von Martens to *Mucronalia*, parasitic on a species of crinoid, later referred by Clark to *Bathymetra*. The specimen has not yet been submitted to the writer, and the figure is insufficient to base a specific description upon. It resembles *Stilifer* (*Mucronalia*) *thomasiae* Sowerby, of the West Indies, and is fixed to one of the arms of the crinoid. If the species is hereafter recovered, it might appropriately take the specific name of *bathymetrae*."

I have not seen a specimen of the species and quote the published text and figure.

Genus LAMBERTIA Souverbie.

Lambertia SOUVERBIE, Journ. de Conch., 1869, p. 420. Type *Lambertia montrouzieri* Souverbie.

Melanellids with mucronate apex, pupiform outline, and with the inner lip appressed to the attenuated base of the preceding whorl.

LAMBERTIA COOKEANA, new species.

Plate 49, fig. 1.

Shell ovate, with a narrow cylindric mucro consisting of two turns, following these two turns, the whorls become decidedly gibbose and appressed at the summit. Surface of the whorls marked by exceedingly retractive lines of growth and very fine microscopic spiral striations. Periphery of the last whorl well rounded. Base moderately long, stout, curved, and revolute; parietal wall covered by a thick callus.

The type (Cat. No. 150869, U.S.N.M.) has four whorls in addition to the mucro, and measures—length, 3.7 mm.; diameter, 2 mm. It and 10 specimens were collected by Miss Cooke at San Hipolito Point, Lower California.

The following additional specimens have been examined:

Number of specimens.	Collection of—	Catalogue number.	Locality.
50	Cooke		San Hipolito Point, Lower California.
2	U.S.N.M.	215791	Point Abreojos, collected by Mr. H. Hemphill.
7	Oldroyd		Do.

EXPLANATION OF PLATES.

PLATE 34.

FIG. 1. *Melanella micans* Carpenter, Fossil, Upper San Pedro Series, length 10.6 mm.
2. *Melanella micans* Carpenter, Fossil, Lower San Pedro Series, length 10.2 mm.
3. *Melanella micans* Carpenter, Fossil, Upper San Pedro Series, length 11.2 mm.
4. *Melanella micans* Carpenter, Fossil, Upper San Pedro Series, length 12.7 mm
5. *Melanella micans* Carpenter, a typical specimen, length 12.7 mm.
6. *Melanella micans* Carpenter, type, length 9.4 mm.

PLATE 35.

FIG. 1. *Melanella ochsneri* Bartsch, topotype, length 8.3 mm.
2. *Melanella rutila* Carpenter, type, length 6.8 mm.
3. *Melanella rutila* Carpenter, Fossil, Lower San Pedro Series, length 5.8 mm
4. *Melanella solitaria* C. B. Adams, type, length 4.7 mm.
5. *Melanella dalli* Bartsch, type, length 20 mm.
6. *Melanella rutila* Carpenter, Fossil, Upper San Pedro Series, length 6.2 mm.
7. *Melanella micans borealis* Bartsch, type, length 11.3 mm.

PLATE 36.

FIG. 1. *Melanella panamensis* Bartsch, type, length 2.8 mm.
2. *Melanella monicensis* Bartsch, type, length 8 mm.
3. *Melanella necropolitana* Bartsch, type, length 7.5 mm.
4. *Melanella linearis* Carpenter, length 2.6 mm.
5. *Melanella oldroydi* Bartsch, Fossil, Upper San Pedro Series, length 7.8 mm.
6. *Melanella oldroydi* Bartsch, type, length 9.2 mm.
7. *Melanella oldroydi* Bartsch, Fossil, Lower San Pedro Series, length 8.1 mm.

PLATE 37.

FIG. 1. *Melanella californica* Bartsch, type, length 6.2 mm.
2. *Melanella baldra* Bartsch, type, length 5.1 mm.
3. *Melanella compacta* Carpenter, type, length 6.8 mm.
4. *Melanella randolphi* Vanatta, type, length 7 mm.
5. *Melanella mexicana* Bartsch, type, length 6.4 mm.
6. *Melanella hemphilli* Bartsch, type, length 8.3 mm.

PLATE 38.

FIG. 1. *Melanella retexta* Carpenter, type, length 2.2 mm.
2. *Melanella pusilla* Sowerby, type, length — mm.
3. *Melanella gabbiana* Anderson and Martin, type, length 4 mm.
4. *Melanella hastata* Sowerby, cotype, length — mm.
5. *Melanella tacomaensis* Bartsch, type, length 5 mm.
6. *Melanella hastata* Sowerby, cotype, length — mm.

PLATE 39.

FIG. 1. *Melanella elodia* de Folin, type, length 5 mm.
2. *Melanella* (*Balcis*) *draconis* Bartsch, type, length 6.1 mm.
3. *Melanella recta* C. B. Adams, type, length — mm.
4. *Melanella* (*Balcis*) *peninsularis* Bartsch, type, length 5.2 mm.
5. *Melanella producta* Carpenter, type, length 3 mm.
6. *Melanella* (*Balcis*) *montereyensis* Bartsch, type, length 5.8 mm.

PLATE 40.

FIG. 1. *Melanella* (*Balcis*) *townsendi* Bartsch, type, length 3.8 mm.
2. *Melanella* (*Balcis*) *halia* Bartsch, type, length 1.8 mm.
3. *Melanella* (*Balcis*) *lastra* Bartsch, type, length 4.1 mm.
4. *Melanella abreojosensis* Bartsch, type, length 3.1 mm.
5. *Melanella* (*Balcis*) *iota* C. B. Adams, type, length 1.7 mm.
6. *Melanella* (*Balcis*) *cosmia* Bartsch, type, length 2.7 mm.
7. *Melanella* (*Balcis*) *catalinensis* Bartsch, type, length 5.2 mm.
8. *Melanella* (*Balcis*) *arnoldi* Bartsch, type, length 5.5 mm.
9. *Melanella* (*Balcis*) *yod* Carpenter, type, length 0.9 mm.

PLATE 41.

FIG. 1. *Melanella* (*Balcis*) *lowei* Vanatta, type, length 6.85 mm.=*Melanella* (*Balcis*) *thersites* Carpenter.
2. *Melanella* (*Balcis*) *thersites* Carpenter, type, length 5.1 mm.
3. *Melanella* (*Balcis*) *bistorta* Vanatta, type, length 5.9 mm.=*Melanella* (*Balcis*) *thersites* Carpenter.
4. *Melanella* (*Balcis*) *comoxensis* Bartsch, type, length 7.1 mm.
5. *Melanella* (*Balcis*) *columbiana* Bartsch, type, length 9.5 mm.
6. *Melanella* (*Balcis*) *macra* Bartsch, type, length 7.5 mm.

PLATE 42.

FIG. 1. *Melanella* (*Balcis*) *adamantina* de Folin, type, length 2.5 mm.
2. *Melanella* (*Balcis*) *taravali* Bartsch, type, length 1.2 mm.
3. *Melanella* (*Balcis*) *berryi* Bartsch, type, length 6 mm.
4. *Melanella* (*Balcis*) *prefalcata* Bartsch, type, length 6.9 mm.
5. *Melanella* (*Balcis*) *grippi* Bartsch, type, length 8 mm.
6. *Melanella* (*Balcis*) *falcata* Carpenter, type, length 7.6 mm.

PLATE 43.

FIG. 1. *Eulimostraca galapagensis* Bartsch, type, length 3.8 mm.
2. *Melanella* (*Balcis*) *gibba* de Folin, type, length 3 mm.
3. *Sabinella meridionalis* Bartsch, type, length 3.9 mm.
4. *Sabinella chathamensis* Bartsch, type, length 3.8 mm.
5. *Sabinella bakeri* Bartsch, type, length 2.7 mm.
6. *Haliella chilensis* Bartsch, type, length 5.5 mm.
7. *Sabinella opalina* de Folin, type, length 9.5 mm.
8. *Haliella abyssicola* Bartsch, type, length 10.4 mm.

PLATE 44.

FIG. 1. *Haliella lomana* Dall, type, length 20.2 mm.
2. *Sabinella* (?) *ptilocrinicola* Bartsch, type, length 9.5 mm.

PLATE 45.

FIG. 1. *Strombiformis alaskensis* Bartsch, type, length 4.2 mm.
2. *Scalenostoma babylonia* Bartsch, type, length 3 mm.
3. *Strombiformis riversi* Bartsch, type, length 12 mm.
4. *Scalenostoma rangii* de Folin, type, length 2.7 mm.
5. *Strombiformis californica* Bartsch, type, length 11.5 mm.

PLATE 46.

FIG. 1. *Strombiformis fuscostrigata* Carpenter, type, length 4.7 mm.
2. *Strombiformis panamensis* Bartsch, type, length 6 mm.
3. *Strombiformis lapazana* Bartsch, type, length 7.8 mm.
4. *Strombiformis townsendi* Bartsch, type, length 11 mm.
5. *Strombiformis almo* Bartsch, type, length 7 mm.

PLATE 47.

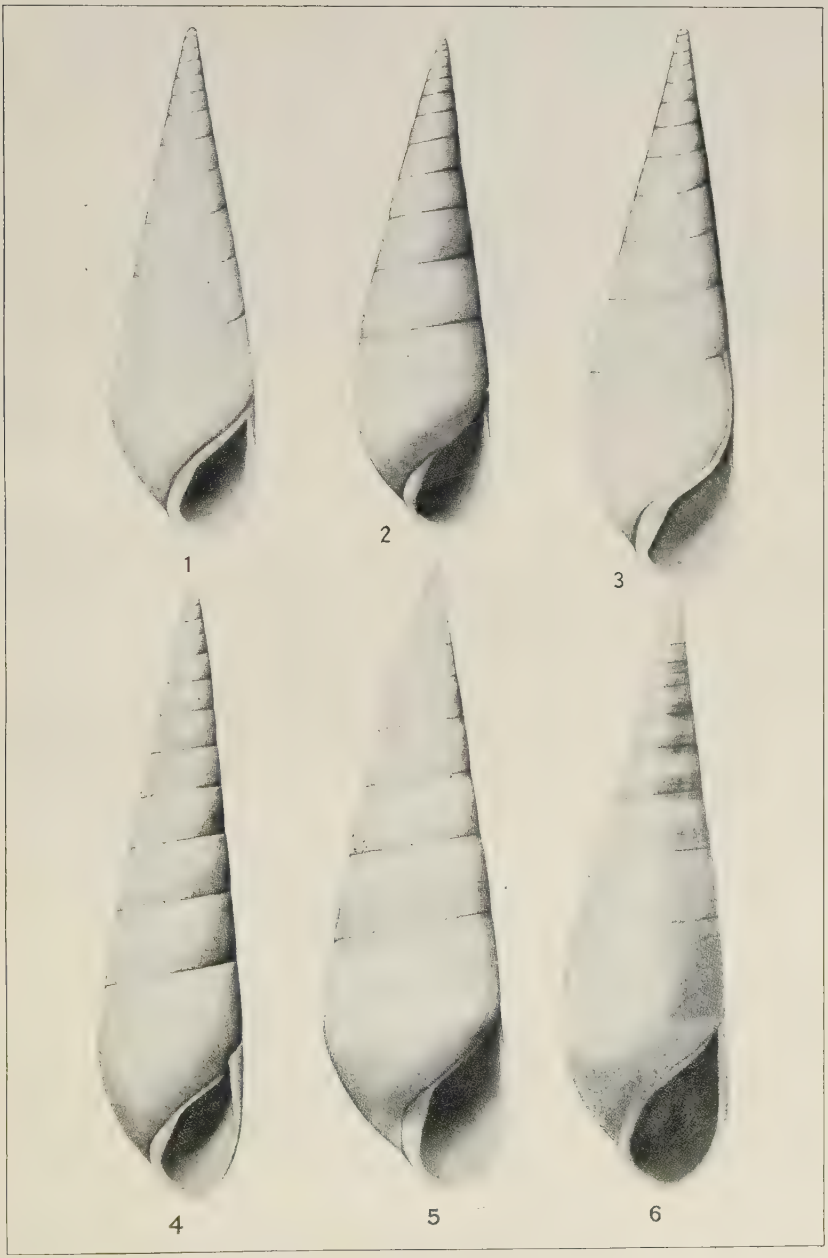
FIG. 1. *Strombiformis proca* de Folin, type, length 3.3 mm.
2. *Strombiformis acuta* Sowerby, type, length — mm.
3. *Strombiformis elegantissima* de Folin, type, length 5 mm.
4. *Strombiformis hemphilli* Bartsch, type, length 3.1 mm.
5. *Strombiformis burragei* Bartsch, type, length 2.7 mm.
6. *Strombiformis varians* Sowerby, cotype.
7. *Strombiformis barthelowi* Bartsch, type, length 5 mm.
8. *Strombiformis varians* Sowerby, cotype.

PLATE 48.

FIG. 1. *Niso interrupta* Sowerby, length 10.3 mm.
2. *Niso* (?) *antiselli* Anderson and Martin, type, length 7.5 mm.
3. *Niso interrupta* Sowerby.
4. *Niso excolpa* Bartsch, type, length 17.5 mm
5. *Niso splendidula* Sowerby, type, length 38 mm.
6. *Niso imbricata* Sowerby, type, length 21 mm.

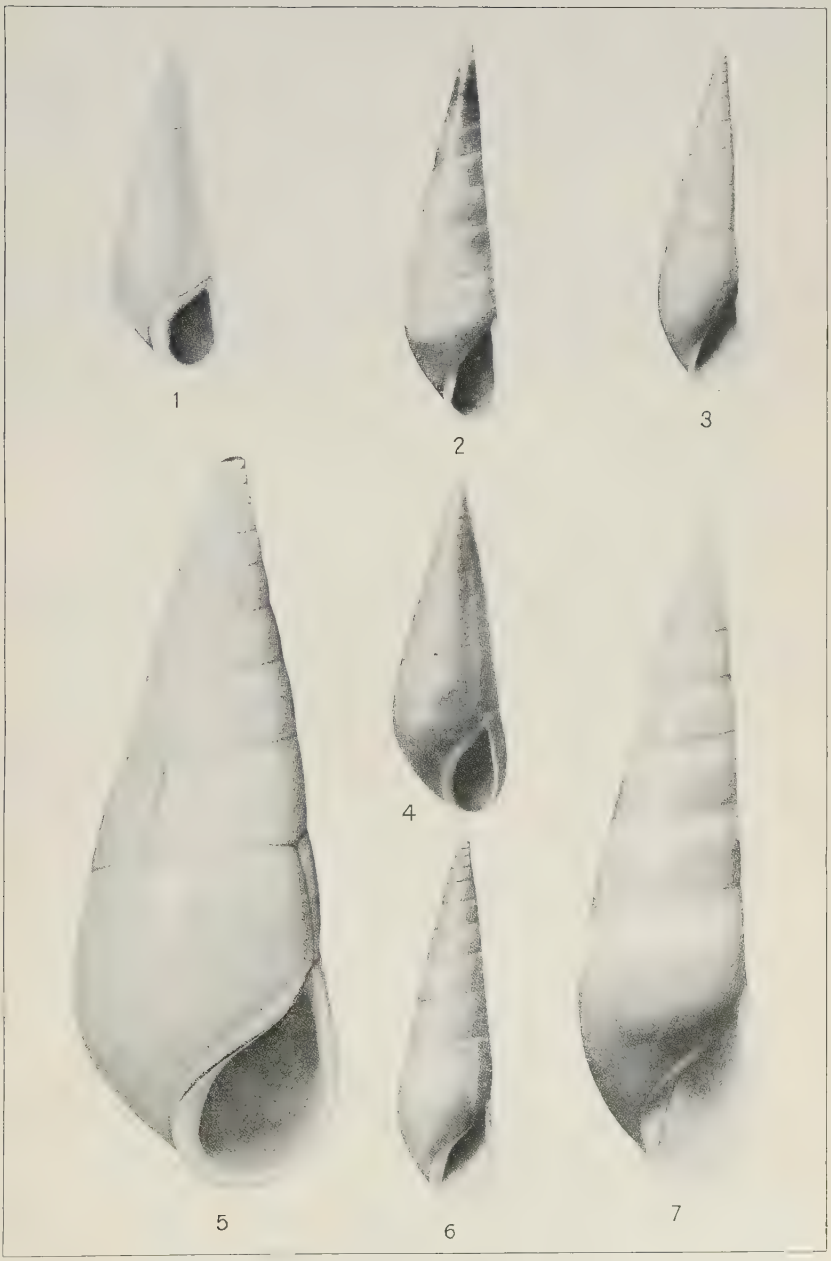
PLATE 49.

FIG. 1. *Lambertia cookeana* Bartsch, type, length 3.7 mm.
2. *Stilifer astericola* Broderip, length 8.6 mm.
3. *Mucronalia* (?) *bathymetrae* Dall, type.
4. *Niso lomana* Bartsch, type, length, 14.5 mm.
5. *Niso hipolitensis* Bartsch, type, length 3.1 mm.



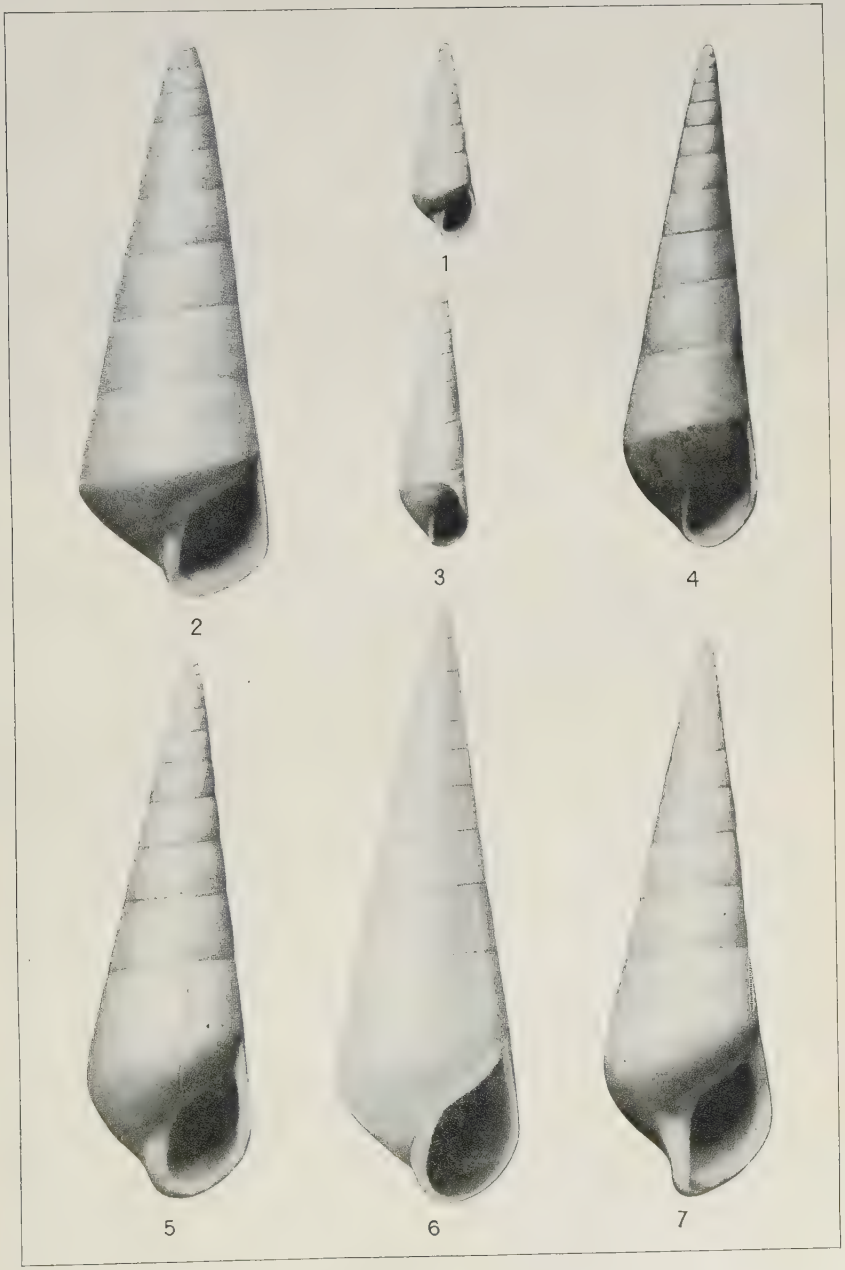
WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 354.



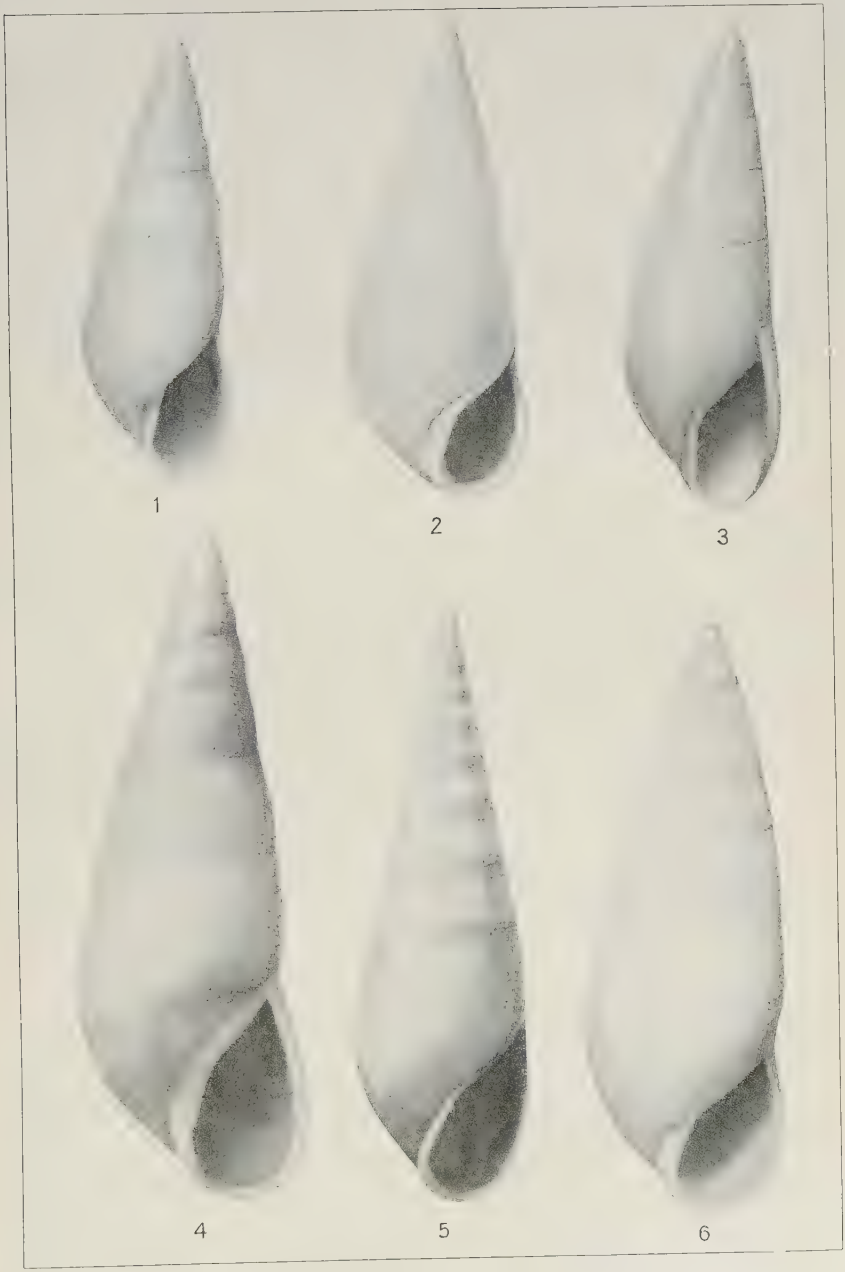
WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 354.



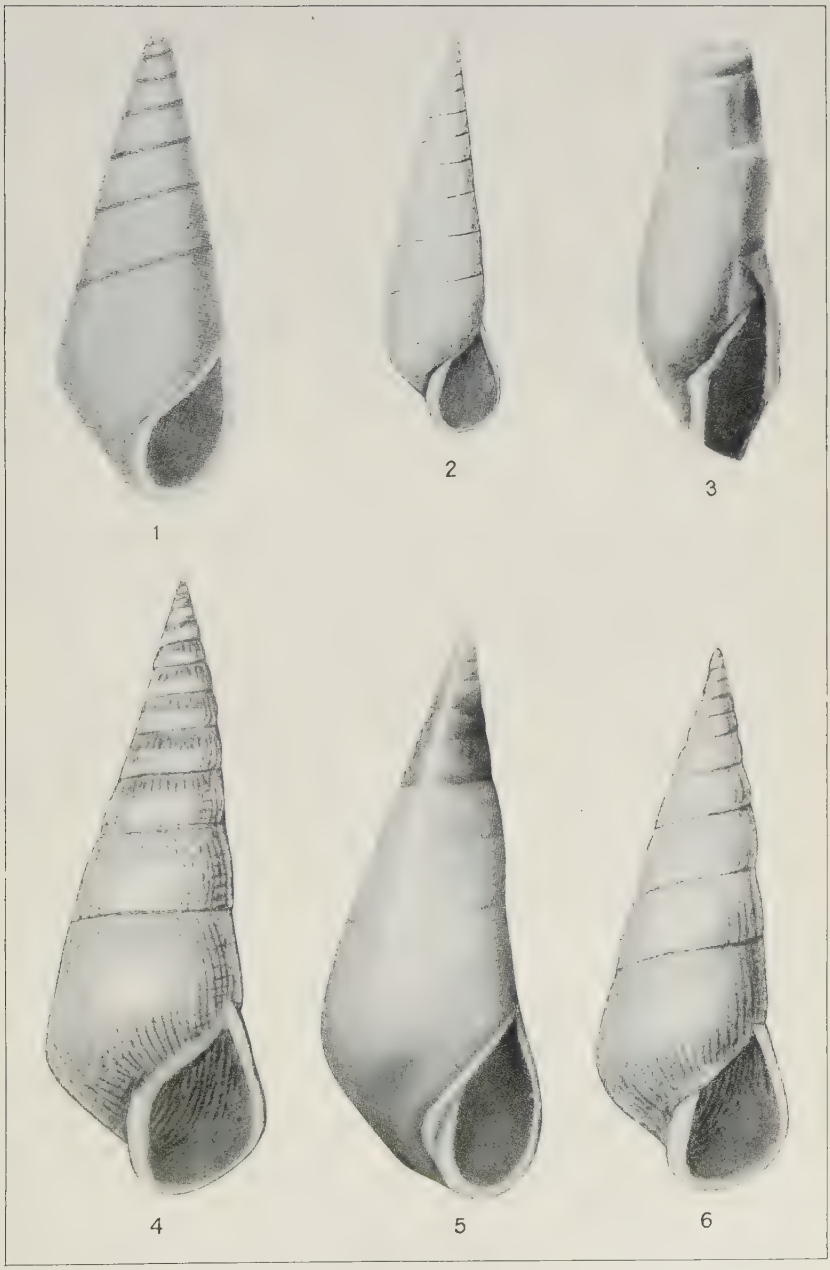
WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 354.



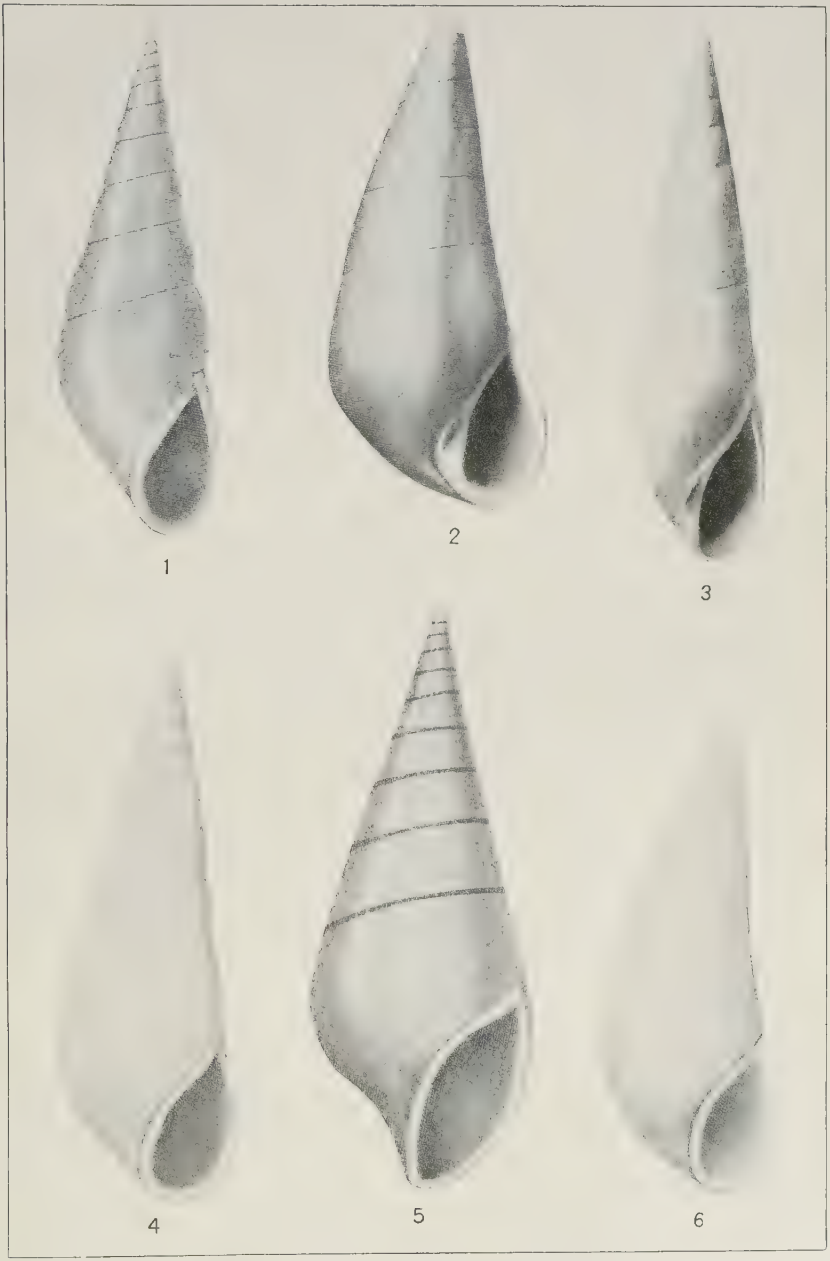
WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 355.



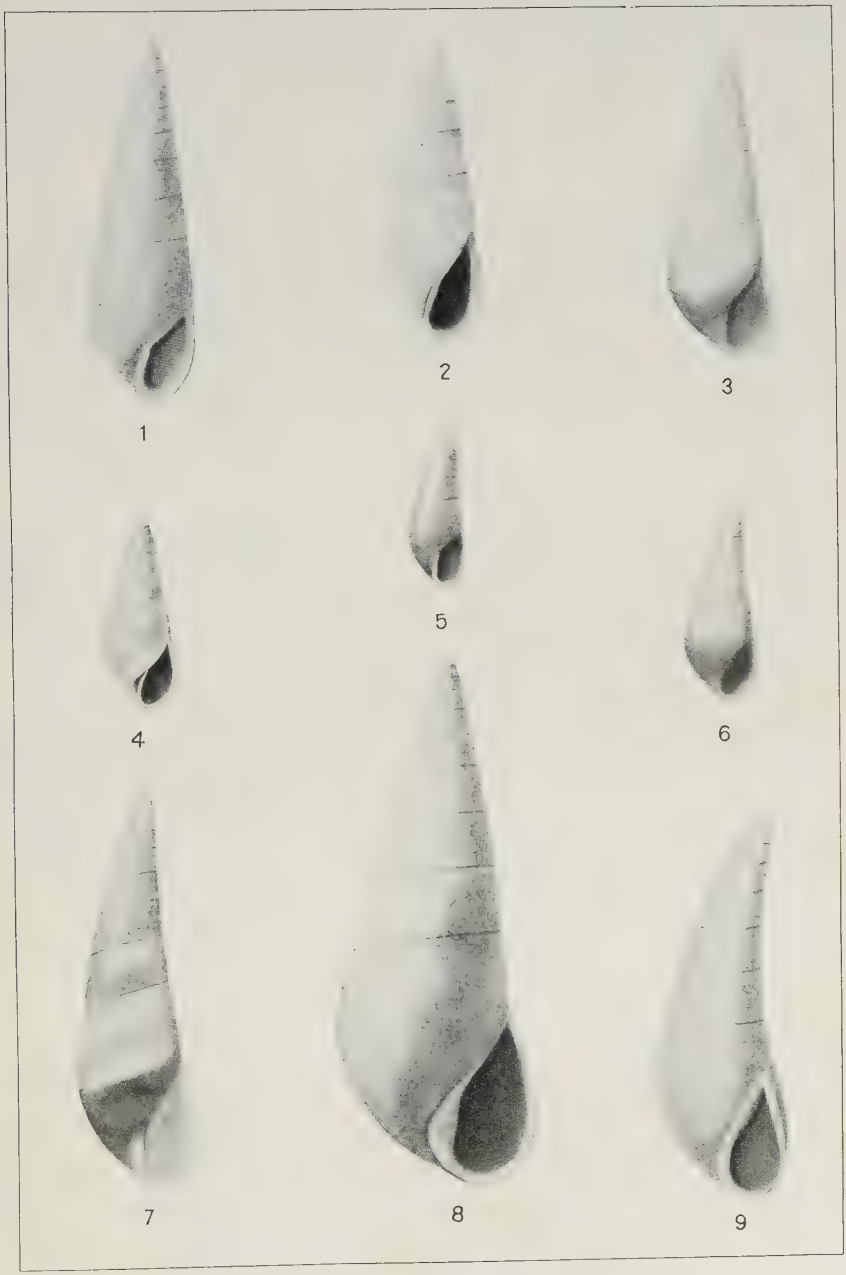
WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 355.



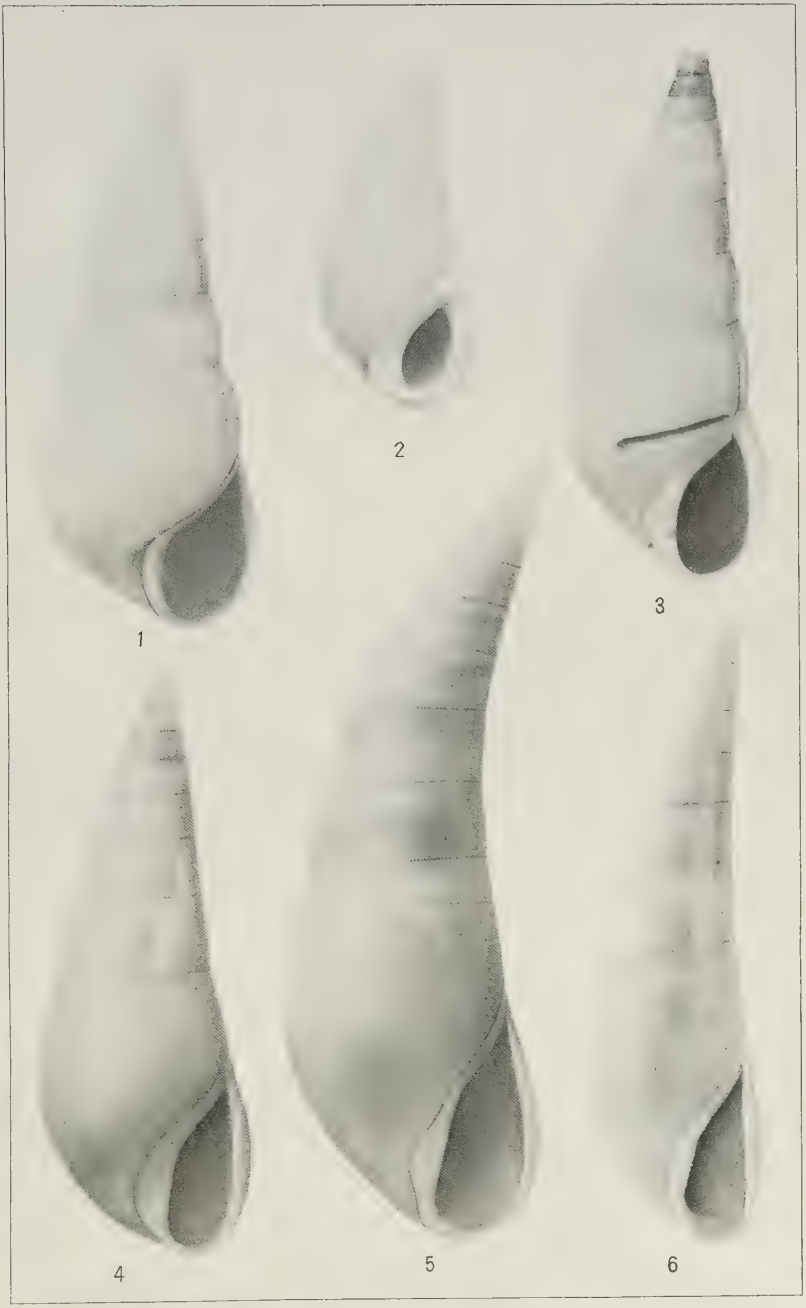
WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 355.



WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 355.



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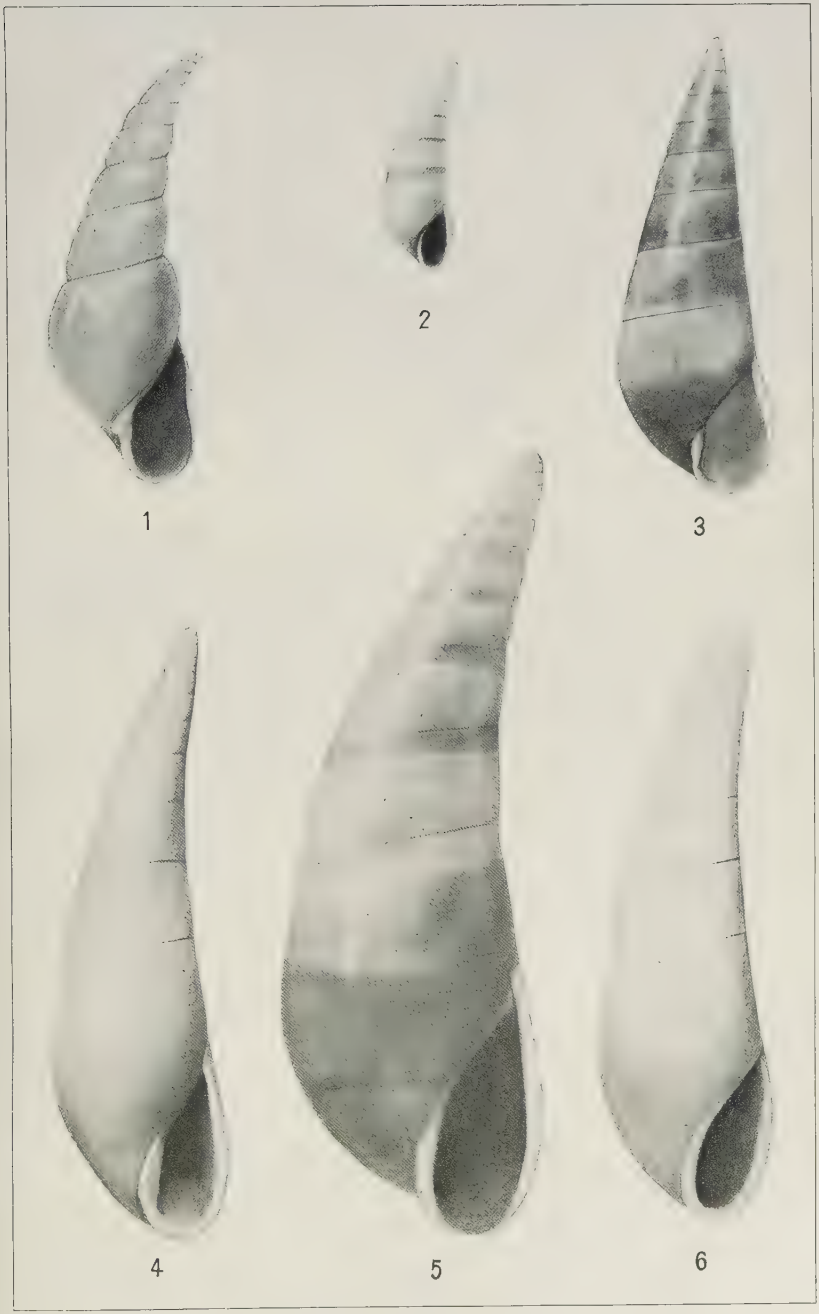
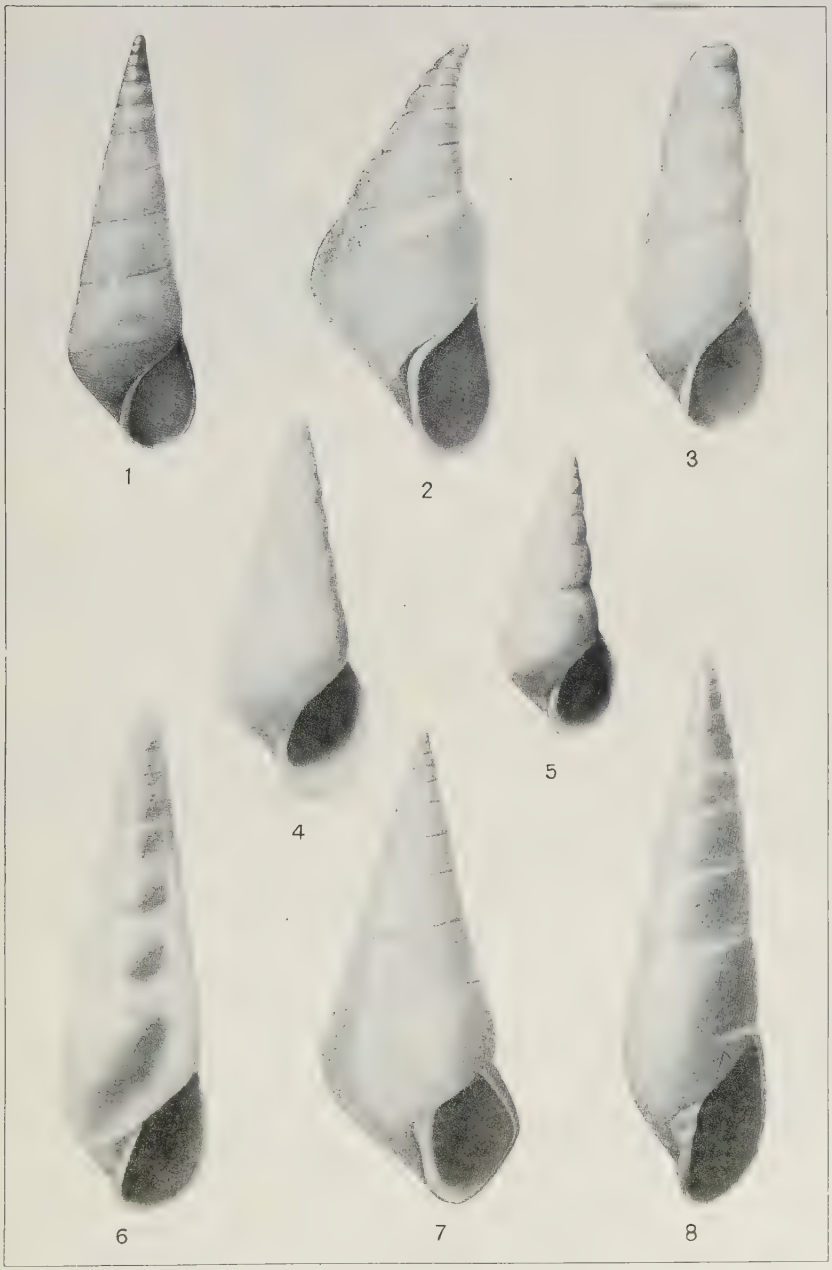
FOR EXPLANATION OF PLATE SEE PAGE 355.



WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 355.

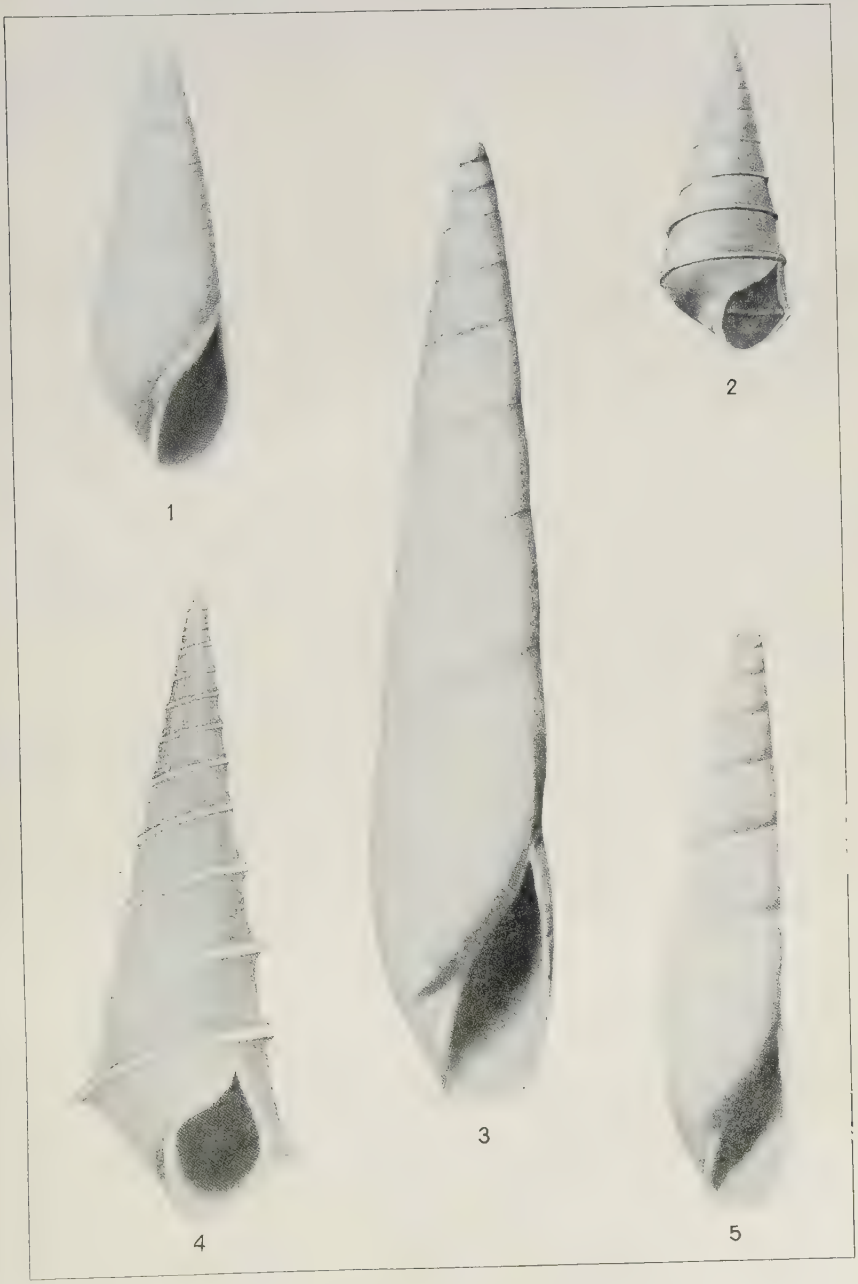


WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 356.

WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 356

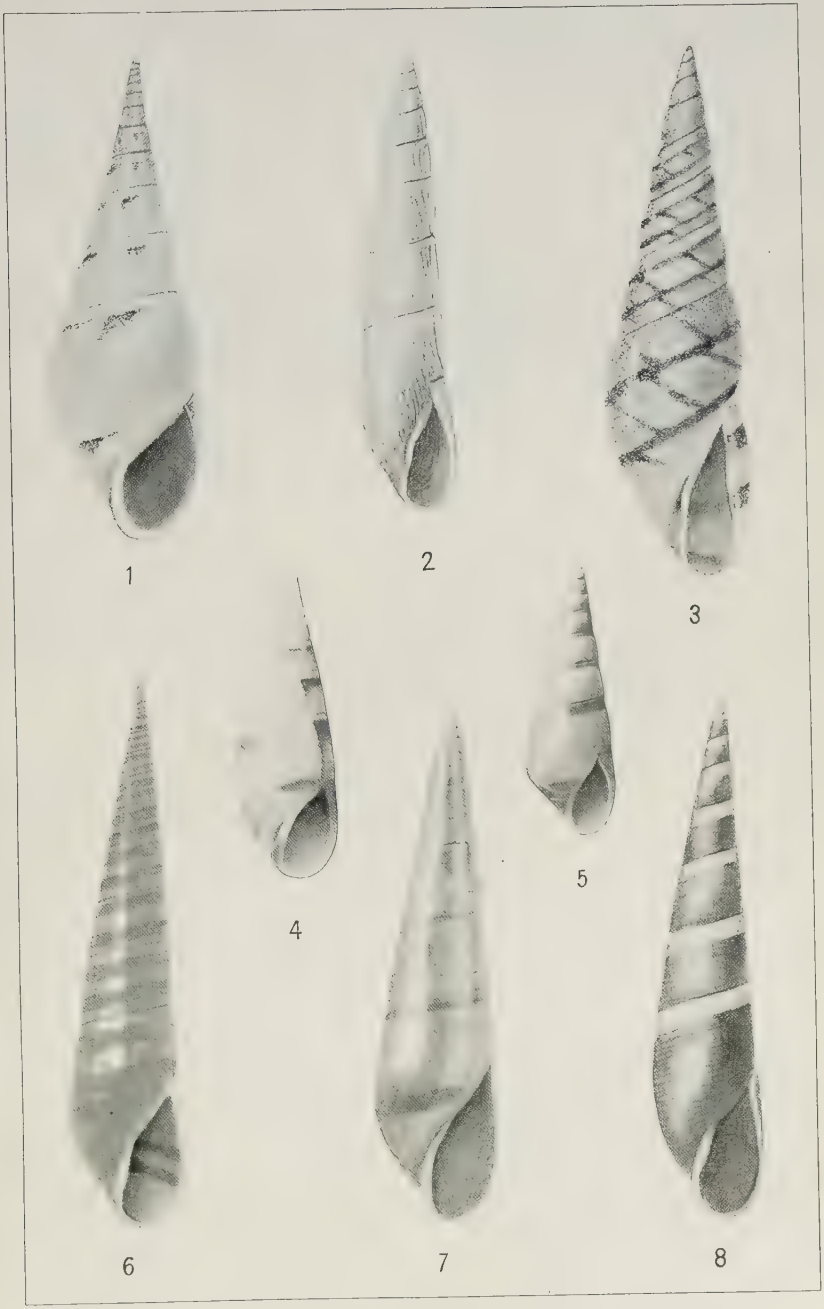


WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 356.

WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 356.



WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 356

WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 356.

WEST AMERICAN MELANELLID MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 356.

THE TYPE-SPECIES OF THE GENERA OF THE CYNIPOIDEA, OR THE GALL WASPS AND PARASITIC CYNIPOIDS.

By S. A. Rohwer and Margaret M. Fagan,

Of the Bureau of Entomology, United States Department of Agriculture.

PREFACE.

In recent years there has been considerable agitation, especially among economic and biological students, for the conservation of well-known generic names, but, if we can judge from the published expression of opinions, there is almost a balance between zoologists who favor conservation and those who favor strict priority. One of the first steps toward stability in generic nomenclature is the determination and designation of the genotypes. In the following paper, which is a contribution from the Branch of Forest Insects, Bureau of Entomology, prepared under the writer's direction, the genotypes of the Cynipoid genera are designated. All of the bibliographical and clerical work connected with this paper has been done by Miss Margaret M. Fagan, but the writer has examined, assisted, and approved the nomenclatorial details. The nomenclature is based on the rules of the International Commission of Zoological Nomenclature, and it is believed that the decisions as to genotypes will be supported, according to available evidence, by these rulings. Certain few questions concerning type fixation are not clearly covered by the International Code, and in these cases the decisions reached have been guided by the A. O. U. Code and consultation with Dr. Leonhard Stejneger and students in the Division of Insects of the United States National Museum.

The restriction of the two oldest generic names in the Cynipoidea, *Cynips* and *Diplolepis*, has heretofore never been satisfactorily determined. With *Diplolepis* especially has there been much uncertainty, as may be illustrated by the fact that in Catalogus Hymenopterorum Dalla Torre considers it a Chalcidoid, while in Das Tierreich, in conjunction with Kieffer, he places it among the gall-making Cynipoids. The literature on these two genera has been very carefully studied and it is believed that the decisions concerning them are correct. That these and the other changes are necessary is regrettable.

S. A. Rohwer.

INTRODUCTION.

The following is an alphabetical catalogue of the 255 genera of the Cynipoidea with the type-species of each genus. The original references to all the genera have been examined and it is believed that the list as here given is correct, and complete up to July 1, 1916, according to the literature received in the libraries at Washington, District of Columbia.

The first attempt to fix genotypes of the genera of the Cynipoidea was made by Latreille in 1810, but as, unfortunately, he chose species not originally included, his type fixations are invalid. The next author to designate genotypes was Westwood, who, in 1840, designated types of the common British genera. Förster, in 1869, in his tabulation of the genera and species of gall-wasps, designated types for all the genera of Cynipoidea then known. In most cases of the older genera of the Cynipoidea his designation was correct, but in some cases, as *Cynips*, he chose as the type a species not originally included, so, according to present rulings, these designations cannot be accepted. Ashmead, in his classification, 1903, chose types for most of the genera and most of his designations are valid. Dalla Torre and Kieffer, in 1910, give a list of the genera of the Cynipoidea with the species which were originally included and also the type designations which were given by the original describers. The present paper is, however, the first comprehensive study of all the genera of the Cynipoidea with the idea of fixing the types from the purely nomenclatorial standpoint.

Up to the present Hartig's first paper on the classification of the Cynipoidea[1] has been given the date 1840. There is evidence, however, that Hartig finished the paper in May, 1839, and that it was reviewed by Erichson in Wiegmann's Archiv für 1840,[2] in connection with other entomological literature for the year 1839. It should, therefore, be given the date 1839. In the following list all of the new genera described in this paper are cited as 1839 in parentheses, followed by 1840, which indicates that 1840 is the date on the title page of the volume in which they appear.

The words "monobasic," "isogenotypic," etc., have the same conception as that indicated in Bulletin 83, United States National Museum.

The method of treatment is as follows: First, the generic name; second, the author; third, the reference; fourth, the number of species originally included (unless monobasic); fifth, the type; sixth, synonymy (if genera are isogenotypic); seventh, the authority

[1] Ueber die Familie der Gallwespen, Germar's Entomologie, vol. 2, pp. 176–209.
[2] Vol. 2, p. 272.

for the type designation; eighth, a list of subsequent or erroneous designations, in brackets. We have placed in the paper all references to type fixation which we know and will welcome any additional designations. When the genotype is placed by Dalla Torre and Kieffer, 1910, in some genus other than the one of which it is the type, a reference to this position has been added.

Throughout the paper the following abbreviations of the more important papers dealing with type fixations are used:

Westwood, 1840.

For WESTWOOD, J. O., Synopsis of the Genera of British Insects, 1840, published as an appendix to An Introduction to the Modern Classification of Insects, vol. 2, London, 1840.

Förster, 1869.

For FÖRSTER, ARNOLD, Ueber die Gallwespen.—Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 327–370.

Ashmead, 1903.

For ASHMEAD, W. H., Classification of the Gall-Wasps and the Parasitic Cynipoids, of the Superfamily Cynipoidea, Psyche, vol. 10, 1903, pp. 7–13, 59–73, 140–155.

Dalla Torre and Kieffer, 1910.

For DALLA TORRE, K. W. von, and KIEFFER, J. J., Das Tierreich, 24 Lieferung, Berlin, 1910.

CATALOGUE OF GENERA.

Acanthaegilips ASHMEAD.

Psyche, vol. 8, 1897, p. 67.

Type.—*Acanthaegilips braziliensis* ASHMEAD. (Monobasic.)

Acantheucoela ASHMEAD.

Trans. Ent. Soc. London, 1900, p. 333.

Type.—*Cynips armatus* CRESSON. (Monobasic and designated by Ashmead, 1903, p. 67.)

Acothyreus ASHMEAD.

Trans. Amer. Ent. Soc., vol. 14, 1887, p. 157.

Type.—*Acothyreus osceola* ASHMEAD. (Monobasic, original designation and 1903.)

Acraspis MAYR.

20 Jahresber. Comm. Oberrealsch. I, Bez. Wien, 1881, pp. 2, 29. (Two species.)

Type.—*Cynips pezomachoides* OSTEN-SACKEN. (Present designation.)

Adieris FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 344, 357.

Type.—*Adieris reclusa* FÖRSTER. (Monobasic and original designation.)

Adleria, new name=(Cynips AUTHORS, not LINNAEUS.

Type.—*Cynips kollari* HARTIG.

(See discussion under *Cynips* and *Diplolepis*.)

Aegilips (Haliday) WALKER.

Entom. Magaz., vol. 3, 1835, p. 160. Three species.

Type.—*Cynips nitidula* DALMAN. (Designated by Westwood, 1840, Synopsis, p. 56, and Förster, 1869, p. 362) [*Anacharis rufipes* Westwood, designated by Ashmead, 1903, p. 12, a subsequent designation.]

Aglaotoma FÖRSTER=(**Crypteucoela** KIEFFER).

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 334, 354.

Type.—*Cothonaspis codrina* HARTIG. (Monobasic and original designation.) Förster misidentified Hartig's species and Kieffer proposed to restrict the genus *Aglaotoma* to the species which Förster had before him, which has been renamed as *försteri* by Kieffer. This is not in accord with the rulings of the International Commission of Nomenclature (see Opinions 35). . (*Aglaotoma* Kieffer)=*Aglaotomidea*, n.n.

Aglaotomidea, new name (=**Aglaotoma** KIEFFER, not FÖRSTER).

Type.—*Aglaotoma försteri* KIEFFER (=*codrina* FÖRSTER not HARTIG). (See remarks under *Aglaotoma* Förster.)

Agroscopa FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 343, 352.

Type.—*Agroscopa helgolandica* FÖRSTER. (Monobasic and original designation.)

[Genotype placed in *Aphyoptera* FÖRSTER by Dalla Torre and Kieffer, 1910, p. 198.]

Allocynips KIEFFER.

Phil. Journ. Sci., vol. 9, 1914, p. 185.

Type.—*Allocynips ruficeps* KIEFFER. (Original designation and monobasic.)

(**Allotria** WESTWOOD, not HÜBNER, 1816)=**Charips** HALIDAY.

Magaz. Nat. Hist., vol. 6, 1833, p. 494.

Type.—*Allotria victrix* WESTWOOD. (Monobasic.)

Alloxysta FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 338, 340.

Type.—*Xystus macrophadnus* HARTIG. (Monobasic and original designation.)

(**Amblynotus** HARTIG) (=**Scytodes** HARTIG, not WALCKENAER, 1805)=**Melanips** (WALKER) GIRAUD.

Zeitschr. f. Entom., vol. 4, 1843, p. 419. =New name for *Scytodes* HARTIG, 1840, not WALCKENAER, 1805.)

Type.—*Scytodes opacus* HARTIG. (Present designation.)

[Type.—*Scytodes granulatus* Hartig, teste Ashmead, 1903, p. 9; not one of the originally included species of *Scytodes* (included in vol. 3, 1841), but in the genus when new name was proposed, but can not be type because a new name takes type of old genus which must be an originally included species.]

Isogenotypic with *Melanips* (Walker) Giraud.

(**Ameristus** FÖRSTER)=**Neuroterus** HARTIG.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 330, 333. (Two species.)

Type.—*Neuroterus politus* HARTIG. (Present designation.) Isogenotypic with *Neuroterus* Hartig.

Amphibolips REINHARD.

Berlin Entom. Zeitschr., vol. 9, 1865, p. 10. (Three species.)

Type.—*Cynips spongifica* OSTEN-SACKEN. (Original designation).

Amphithectus HARTIG.

Zeitschr. f. Entom., vol. 2, (1839) 1840, p. 203.

Type.—(*Amphithectus dahlbohmii* HARTIG.) (Monobasic.) =*Sarothrus areolatus* HARTIG.

[Genotype placed in *Sarothrus* HARTIG by Dalla Torre and Kieffer, 1910, p. 74.]

Anacharis DALMAN.

Anal. Entom., 1823, p. 96.

Type.—*Cynips eucharioides* DALMAN. (Monobasic.)

Anacharoides CAMERON.

Rec. Albany Museum, vol. 1, 1903–06, p. 160.

Type.—*Anacharoides striaticeps* CAMERON. (Monobasic.)

Andricus HARTIG.

Zeitschr. f. Entom., vol. 2 (1839), 1840, pp. 185, 190. Nine species.

Type.—(*Andricus noduli* HARTIG.) (Designated by Förster, 1869, p. 335.) = *Andricus trilineatus* HARTIG.

Anectoclis FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 345, 359. Two species.

Type.—*Anectoclis indagatrix* FÖRSTER. (Original designation.) [*Eucoela filicornis* Thomson, designated by Cameron 1889.]

Anolytus FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 363, 365.

Type.—*Anolytus rufipes* FÖRSTER. (Monobasic and original designation.)

[Type.—*Onychia biusta* Haliday, designated by Ashmead, 1903, p. 11, a subsequent designation.]

Antistrophus WALSH.

Amer. Entomol., vol. 2, 1869, p. 74.

Type.—*Antistrophus ligodesmiae-pisum* WALSH. (Monobasic.)

Aphelonyx MAYR.

20 Jahresber. Comm. Oberrealsch. I, Bez. Wien, 1881, pp. 5, 29.

Type.—*Cynips cerricola* GIRAUD. (Monobasic.)

Aphiloptera FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 343, 351. Two species.

Type.—*Aphiloptera anisomera* FÖRSTER. (Original designation.)

Aphilothrix FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 331, 336.

Type.—*Cynips corticis* LINNAEUS. (Monobasic and original designation.)

[Genotype placed in *Andricus* by Dalla Torre and Kieffer, 1910, p. 477.]

Aphyoptera FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 343, 351.

Type.—*Aphyoptera inustipennis* FÖRSTER. (Monobasic and original designation.)

(Apistophyza FÖRSTER**) = Glauraspidia** THOMSON.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 343, 351.

Type.—(*Cothonaspis microptera* HARTIG.) (Monobasic and original designation.) = *Glauraspidia subtilis* DAHLBOM. Isogenotypic through synonymy with *Glauraspidia* Thomson.

(Apophyllus HARTIG**) = Biorhiza** WESTWOOD.

Zeitschr. f. Entom., vol. 2 (1839), 1840, p. 185.

Type.—*Cynips aptera* FABRICIUS. (Monobasic.)

Isogenotypic with *Biorhiza* Westwood.

Aporeucoela KIEFFER.

Ann. Soc. Sci. Brux., vol. 32, 1908, p. 49.

Type.—*Aporeucoela fuscipes* KIEFFER. (Monobasic.)

Arhoptra KIEFFER.

Feuille Jeunes Natural., vol. 31, 1901, p. 161. (Two species.)

Type.—*Eucoila melanopoda* CAMERON. (Designated by Ashmead, 1903, p. 62.)

Asclepiadiphila ASHMEAD.

Can. Ent., vol. 29, 1897, p. 263.

Type.—*Asclepiadiphila stephanotidis* ASHMEAD. (Monobasic.)

[Genotype placed in *Aylax* by Dalla Torre and Kieffer, 1910, p. 677.]

Aspicera DAHLBOM (=**Onychia** (HALIDAY) WALKER, not HÜBNER, 1816) (=**Bellona** GIRAUD.)

Onychia and Callaspidia, 1842, p. 6.

Type.—(*Cynips ediogaster* PANZER)=(*Tenthredo*) *Aspicera scutellata* (VILLERS).

[A new name for *Onychia* (Halliday, Walker), not Hübner, and takes same type as genus for which it was proposed.] Isogenotypic with *Bellona* Giraud.

Aulacidea ASHMEAD.

Psyche, vol. 8, 1897, p. 68. Many species, only one named.

Type.—*Aulax mulgediicola* ASHMEAD. (Present designation.)

Auloxysta THOMSON.

Opusc. entom., P. 8, 1877, p. 811. Seven species.

Type.—*Auloxysta stricta* THOMSON. (Present designation.)

[Genotype placed in *Phaenoglyphis* FÖRSTER by Dalla Torre and Kieffer, 1910, p. 294.]

Aylax HARTIG.

Zeitschr. f. Ent., vol. 2, (1839) 1840, pp. 195–6. Eight species.

Type.—*Cynips rhocados* BOUCHÉ. (Designated by Ashmead, 1903, p. 213.)

[Dalla Torre and Kieffer treat this as questionably the same as *papaveris* (Perris).]

Balna CAMERON.

Biol. Centr.-Amer., P. 27, 1883, p. 74, Hymen. I.

Type.—*Balna nigriceps* CAMERON. (Monobasic.)

Bassettia ASHMEAD.

Trans. Amer. Ent. Soc., vol. 14, 1887, p. 146. Two species.

Type.—*Bassettia floridana* ASHMEAD. (Designated by Ashmead, 1903, p. 155.)

(**Bathyaspis** FÖRSTER)=**Pediaspis** TISCHBEIN.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 330, 332.

Type.—(*Bathyaspis accris* FÖRSTER.) (Monobasic and original designation.) =(*Cynips*) *Pediaspis accris* (GMELIN). Isogenotypic through synonymy with *Pediaspis* Tischbein.

Belenocnema MAYR.

20 Jahresber. Comm. Oberrealsch. I, Bez. Wien, 1881, p. 4, 16.

Type.—*Belenocnema treatae* MAYR. (Monobasic.)

(**Bellona** GIRAUD)=**Aspicera** DAHLBOM.

Verh. Zool.-Bot. Ges. Wien, vol. 10, 1860, p. 156 (not Rechb. 1852, Birds).

Type.—(*Cynips ediogaster* PANZER)=*Aspicera scutellata* (VILLERS). An uncalled for new name for *Onychia* Westwood, not Hübner. Isogenotypic with *Aspicera* Dahlbom.

Biorhiza WESTWOOD=(**Apophyllus** HARTIG=**Heterobius** GUÉRIN).

Introd. Mod. Classific. Insect. II, Synopsis, 1840, p. 56.

Type.—*Cynips aptera* FABRICIUS. (Monobasic and original designation.)

According to our present knowledge of the date of publication of *Biorhiza* it would be necessary to consider it a synonym of *Apophyllus*. This we hesitate to do because of Erichson's statement (Wiegmann's Archiv Naturg., vol. 2, 1840, p. 274), which quotes *Apophyllus* as a synonym of *Biorhiza* and indicates that the name was proposed prior to the Synopsis. We therefore prefer to leave the date of publication of *Biorhiza* open to future investigations.

Bothrioxysta KIEFFER.

Bull. Soc. Hist. Nat. Metz (2), vol. 10, 1901, p. 9. Five species

Type.—*Auloxysta nigripes* THOMSON. (Present designation.)

Bothrochacis CAMERON.

Records Albany Museum, vol. 1, 1903–06, p. 163.

Type.—*Bothrochacis erythropoda* CAMERON. (Monobasic.)

Caleucoela KIEFFER.

Bull. Soc. Hist. Nat. Metz, vol. 26, 1909, p. 62.

Type.—*Caleucoela striatipennis* KIEFFER. (Monobasic.)

Callaspidia DAHLBOM.

Onychia and Callaspidia, 1842, p. 10. Two species.

Type.—*Callaspidia de fonscolombei* DAHLBOM. (Present designation.)

Callirhytis FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 331, 335.

Type.—*Callirhytis hartigi* FÖRSTER. (Monobasic and original designation.)

Calofigites KIEFFER.

Bull. Soc. Hist. Nat. Metz, vol. 26, 1909, p. 93.

Type.—*Calofigites nitidus* KIEFFER. (Monobasic.)

Cecconia KIEFFER.

Bull. Soc. Hist. Nat. Metz, vol. 22, 1902, pp. 7, 93.

Type.—*Aulax valerianellae* THOMSON. (Monobasic and original designations.)

Ceroptres HARTIG.

Zeitschr. f. Entom., vol. 2 (1839), 1840, p. 186. Two species.

Type.—*Ceroptres clavicornis* HARTIG. (Designated by Förster, 1869, p. 364.)

Charips (HALIDAY) MARSHALL=(Allotria WESTWOOD, not HÜBNER, 1816).

Entom. Mon. Mag., vol. 6, 1870, p. 181.

Type.—*Charips microcera* (HALIDAY) MARSHALL. (Monobasic.)

Chilaspis MAYR.

20 Jahresber. Comm. Oberrealsch. I, Bez. Wien, 1881, pp. 6, 32.

Type.—*Andricus nitida* GIRAUD. (Monobasic.)

Chrestosema FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 344, 355.

Type.—*Chrestosema erythropa* FÖRSTER. (Monobasic and original designation.)

Cliditoma FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 342, 348. Five species.

Type.—*Cothonaspis geniculatus* HARTIG. (Original designation.)

[Genotype placed in *Kleidotoma* by Dalla Torre and Kieffer, 1910, p. 205.]

Coelonychia KIEFFER.

Wiss. Ergebn. Deutschr. Zentr. Afr. Exped. 1907–08, vol. 3, 1910, p. 19.

Type.—*Coelonychia spinosipes* KIEFFER. (Monobasic.)

Compsodryoxenus ASHMEAD.

Proc. U. S. Nat. Mus., vol. 19, 1896, p. 128. Two species.

Type.—*Compsodryoxenus maculipennis* ASHMEAD. (Designated by Ashmead, 1903, p. 155.)

Coneucoela KIEFFER.

Reise in Ostafrika v. A. Voeltzk, vol. 2, 1910, p. 534.

Type.—*Concucoela gracilicornis* KIEFFER. (Monobasic.)

Coptereucoila ASHMEAD.

Trans. Amer. Ent. Soc., vol. 14, 1887, p. 151.

Type.—*Coptereucoila americana* ASHMEAD. (Monobasic.) =(*Kleidotoma ashmeadi* KIEFFER.)

[Genotype placed in *Kleidotoma* by Dalla Torre and Kieffer, 1910, p. 208.]

Cothonaspis HARTIG.

Zeitschr. f, Entom., vol. 2, (1839) 1840, p. 186. Fourteen species.

Type.—*Cothonaspis pentatoma* HARTIG. (Designated by Förster, 1869, p. 348.)

[Type.—*Cothonaspis scutellaris* Hartig, designated by Ashmead, 1903, p. 67.]

[Genotype placed in *Pentamerocera* by Dalla Torre and Kieffer, 1910, p. 148.]

(Crypteucoela KIEFFER**)=Aglaotoma** FÖRSTER.

Andre, Spec. Hym. Eur., vol. 7, pl. 2, 1904, p. 618. Two species.

Type.—*Cothonaspis codrina* HARTIG. (Present designation.)

Isogenotypic with *Aglaotoma* Förster.

Cynips LINNAEUS=**(Dryophanta** FÖRSTER**)**.

Syst. Nat., ed. 10a, vol. 1, p. 343, No. 12; p. 553, No. 213.

Type.—*Cynips quercus-folii* LINNAEUS. (Designated by Westwood, 1840, Synopsis, p. 56.) Morice and Durrant 1915 Trans. Ent. Soc. Lond., p. 431, state that Lamarck in 1801 chose *quercus-folii* Linnaeus as type of *Cynips*. With this we can not agree as we do not believe that Lamarck or most of the other old writers' examples are any more than illustrations of the various genera. They therefore can not be accepted as type designations by the International Code, which says, "The meaning of the expression 'select a type' is to be rigidly construed. Mention of a species as an illustration or example of a genus does not constitute a selection of a type."

[*Cynips tinctoria* Linnaeus (Förster, 1869); *Cynips quercus-radicis* Fabricius (Curtis, 1838); *Cynips argentata* Hartig (Ashmead, 1903); *Diplolepis bedeguaris* Fabricius (Latreille, 1810). None of these originally included. *Cynips quercus-gemmae* Linnaeus (Karsch 1880). It is doubtful if this is type designation.] Isogenotypic with *Dryophanta* Förster.

(Cynips AUTHORS**)=Adleria,** new name.

Dallatorrella KIEFFER.

Bull. Soc. Ent. Ital., vol. 41, 1909, p. 244.

Type.—*Dallatorrella rubriventris* KIEFFER. (Monobasic.)

Diastrophus HARTIG.

Zeitschr. f. Entom., vol. 2, (1839) 1840, p. 186.

Type.—*Diastrophus rubi* HARTIG. (Monobasic.)

Diceraea FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 364, 367.

Type.—*Figites urticeti* DAHLBOM. Monobasic and original designation.)

Diceratraspis ASHMEAD.

Proc. Zool. Soc. Lond., 1895, p. 744.

Type.—*Diceratraspis grenadensis* ASHMEAD. (Monobasic.)

Didictyum RILEY.

Amer. Entomol., vol. 3, 1880, pp. 52, 293.

Type.—*Didictyum zigzag* RILEY. (Monobasic.)

[Genotype placed in *Hexaplasta* by Dalla Torre and Kieffer, 1910, p. 117.]

Dieucoila ASHMEAD.

Proc. Ent. Soc. Wash., 1903, p. 222.

Type.—*Dieucoila subopaca* ASHMEAD. (Monobasic and original designation.)

Diglyphosema FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 342, 345.

Type.—*Diglyphosema cupatorii* FÖRSTER. (Monobasic.)

Diholocynips, new name =(**Holocynips** KIEFFER, 1916, not 1910).

Phil. Journ. Sci., vol. 11, 1916, p. 284–285.

Type.—*Holocynips nigra* KIEFFER. (A new name takes same species for type.)

Dilyta FÖRSTER.

Verh. Zool.—Bot. Ges. Wien, vol. 19, 1869, pp. 338, 340.

Type.—*Dilyta subclavata* FÖRSTER. (Monobasic and original designation.) [Genotype placed in *Alloxysta* by Dalla Torre and Kieffer, 1910, p. 255.]

Dimicrostrophis ASHMEAD.

Provancher, 1886, Addit. faun. Canad. Hymen., p. 160, 172.

Type.—*Dimicrostrophis ruficornis* ASHMEAD. (Monobasic.) [Genotype placed in *Eucoela* by Dalla Torre and Kieffer, 1910, p. 177.]

Diplolepis GOEFFROY (=**Rhodites** HARTIG).

Hist. Ins., vol. 2, 1762, p. 308. (Six species by number, the second is in bibliography by reference mentioned by name.)

Fourcroy, 1785, Ent. Paris, p. 391. (Gives names to Geoffroy's six species.)

Type.—*Cynips rosae* LINNAEUS. (Designated by Karsch, 1880.) [*Cynips quercus-folii* Fabricius, designated by Latreille, 1810, p. 436, not originally included.]

NOTE.—Karsch, 1880, Zeit. Gam. Naturh., p. 288, contends that Geoffroy fixed *Cynips rosae* Linnaeus, as the type of *Diplolepis* and in his (Karsch's) discussion he indicates that he approves of this designation. Geoffroy does not, in our opinion, designate the type. We consider that "C'est ce qui nous a porté à distinguer cet insect et à en former un genre separé" refers to the characters rather than a species. There is also some slight doubt whether the implied approval by Karsch of the supposed designation of type by Geoffroy can be considered as type designation for *Diplolepis*. Therefore, inasmuch as there is no other type designation for *Diplolepis* we chose as the type of this genus *Cynips rosae* Linnaeus. This designation can also be supported by the fact that *rosae* is, through the bibliography of species No. 2, the only species in the original description of *Diplolepis* which is mentioned by name. Westwood (Zool Journ., vol. 55 (1828), 1829, pp. 9–16) gives many reasons for suppressing Geoffroy's name, and, as with many authors, even Latreille considers *Diplolepis* Geoffroy a synonym of *Cynips* Linnaeus. It is much to be regretted that these authors did not designate types so it would have been possible to follow their conclusions. We regret very much that Karsch's paper makes it impossible for us to agree with the restriction of *Diplolepis* used by Dalla Torre and Kieffer in Das Tierreich. Isogenotypic with *Rhodites* Hartig.

Diranchis FÖRSTER.

Verh. Zool.—Bot. Ges. Wien, vol. 19, 1869, p. 360.

Type.—*Diranchis copulata* FÖRSTER. (Monobasic and original designation.) [Genotype placed in *Cothonaspis* by Dalla Torre and Kieffer, 1910, p. 124.]

Disholcaspis DALLA TORRE and KIEFFER=(**Holcaspis** MAYR, 1881, not CHAUDOIR, 186– .)

Das Tierreich, 1910, p. 371.

Type.—*Callaspidia quercus-globulus* FITCH.

Disorygma FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 342, 346. Two species.

Type.—*Disorygma divulgata* FÖRSTER. (Original designation.)

Dissodontaspis KIEFFER.

Bull. Soc. Hist. Nat. Metz, vol. 26, 1909, p. 59.

Type.—*Dissodontaspis flavipes* KIEFFER. (Monobasic.)

Ditrupaspis KIEFFER.

Wiss. Ergebn. Deutsch. Zentr. Afr. Exped., 1907–8, vol. 3, 1910, p. 18.

Type.—*Ditrupaspis semirufa* KIEFFER. (Monobasic.)

Dolichostrophus ASHMEAD.

Trans. Amer. Ent. Soc., vol 14, 1887, p. 129, nota.

Type.—*Cynips quercus-irregularis* OSTEN-SACKEN. (Monobasic and original designation.) [*Cynips quercus-majalis* Bassett, designated by Ashmead, 1903, p. 151.] [Genotype placed in *Neuroterus* by Dalla Torre and Kieffer, 1910, p. 335.]

Dryocosmus GIRAUD.

Verh. Zool.-Bot. Ges. Wien, vol. 9, 1859, p. 353.

Type.—*Dryocosmus cerriphilus* GIRAUD. (Monobasic.)

(Dryophanta FÖRSTER**)=Cynips** LINNAEUS.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 331, 335.

Type.—*Cynips quercus-folii* LINNAEUS. (Monobasic and original designation.) Isogenotypic with *Cynips* Linnaeus.

Dryorrhizoxenus ASHMEAD.

Trans. Amer. Ent. Soc., vol. 9, 1881, p. xxv.

Type.—(*Dryorrhizoxenus floridanus* ASHMEAD.) (Monobasic.)=*Belenocnema treatae* MAYR. [Genotype placed in *Belenocnema* by Dalla Torre and Kieffer, 1910, p. 724.]

Dryoteras FÖRSTER=**(Teras** HARTIG, 1839, not TREITSCHKE, 1829).

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 331, 334.

Type.—(*Cynips terminalis* FABRICUS.) (Original designation.)=*Diplolepis pallida* OLIVIER. [Genotype placed in *Biorhiza* by Dalla Torre and Kieffer, 1910, p. 398.]

Ectolyta FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 342, 347.

Type.—*Cothonaspis incrassata* THOMSON. (Monobasic and original designation.)

Entropha FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 330, 334.

Type.—*Entropha lissonota* FÖRSTER. (Monobasic and original designation.) [Genotype placed in *Dryocosmus* by Dalla Torre and Kieffer, 1910, p. 381.]

Episoda FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 343, 353.

Type.—*Episoda xanthoneura* FÖRSTER. (Monobasic and original designation.)

Erisphagia FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 342, 347. Two species.

Type.—*Eucoela depilis* GIRAUD. (Original designation.) [*Eucoela curta* Giraud, designated by ASHMEAD, 1903, p. 61.]

Eschatocerus MAYR.

29 Jahresber. Comm. Oberrealsch. I, Bez, Wien, 1881, pp. 3, 9, 13.

Type.—*Eschatocerus acaciae* MAYR. (Monobasic.)

(Eubothrus FÖRSTER**)=Isocolus** FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19,. 1869, pp. 331, 336.

Type.—*Diastrophus scabiosae* GIRAUD. (Monobasic and original designation.) [Genotype placed in *Aylax* by Dalla Torre and Kieffer, 1910, p. 665.] Isogenotypic with *Isocolus* Förster.

Euceroptres ASHMEAD.

Trans. Amer. Ent. Soc., vol. 23, 1896, p. 187.

Type.—*Euceroptres primus* ASHMEAD. (Monobasic.) [Genotype placed in *Ceroptres* by Dalla Torre and Kieffer, 1910, p. 645.]

Eucoela WESTWOOD.

Magaz. Nat. Hist., vol. 6, 1833, p. 494.

Type.—*Eucoela crassinervis* WESTWOOD. (Monobasic.) [*Cothonaspis cubitalis* Hartig, designated by FÖRSTER, 1869, p. 357.]

Eucoilidea ASHMEAD.

Trans. Amer. Ent. Soc., vol. 14, 1887, p. 154. Two species.

Type.—*Eucoilidea canadensis* ASHMEAD. (Designated by Ashmead, 1903, p. 60.)

Eumayria ASHMEAD.

Trans. Amer. Ent. Soc., vol. 14, 1887, p. 147.

Type.—*Eumayria floridana* ASHMEAD. (Monobasic.)

Eutrias FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 344, 357.

Type.—*Eucoela tritoma* THOMSON. (Monobasic and original designation.)

Figites LATREILLE.

Hist. Nat. Crust. et Insect. vol. 3, 1802, p. 307. Three species.

Type.—*Cynips scutellaris* ROSSI. (Designated by Latreille, 1810, p. 436.)

Figitodes ASHMEAD.

Trans. Amer. Ent. Soc., vol. 14, 1887, p. 150. No species.

ASHMEAD, Psyche, vol. 10, 1903, p. 11. One species.

Type.—*Diplolepis quinquelincatus* SAY. (Designated by Ashmead, 1903, p. 11.) [Genotype placed in *Aspiccra* by Dalla Torre and Kieffer, 1910, p. 57.]

(**Fioria** KIEFFER, not SILVESTRI, 1898)=**Fioriella** KIEFFER.

Bull. Soc. Entom. France, 1903, p. 31.

Type.—*Callirhytis marianii* KIEFFER (agamic form.) *Callirhytis meunieri* KIEFFER (sexual form.) (Original designation.)

Fioriella KIEFFER=(**Fioria** KIEFFER, not SILVESTRI, 1898).

Bull. Soc. Ent. France, 1903, p. 95.

Type.—*Callirhytis marianii* KIEFFER (agamic form.) *Callirhytis meunieri* KIEFFER (sexual form). (Original designation.)

Frireniella KIEFFER.

Bull. Soc. Hist. Nat. Metz, 1909, p. 64.

Type.—*Frireniella bisulcata* KIEFFER. (Monobasic.)

Ganaspis FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, p. 355.

Type.—*Ganaspis mundata* FÖRSTER. (Monobasic and original designation.)

Gillettea ASHMEAD.

Psyche, vol. 8, 1897, p. 69.

Type.—*Gillettea taraxaci* ASHMEAD. (Monobasic and original designation.) [Genotype placed in *Aylax* by Dalla Torre and Kieffer, 1910, p. 665.]

Glauraspidia THOMSON=(**Apistophyza** FÖRSTER).

Ofvers. Svensk. Vet.-Akad. Förh., vol. 18, 1861, pp. 307 and 401.

Type.—*Eucoela subtilis* DAHLBOM. (Monobasic.) (Designated by Förster, 1869, p. 351. ([*Glauraspidia parva* Thomson, designated by Ashmead, 1903, p. 63, not originally included.] Isogenotypic with *Aspistophyza* Förster.

Glyptoxysta THOMSON.

Opusc. entom. P. 8, 1877, p. 811. Two species.

Type.—*Glyptoxysta xanthocephala* THOMSON. (Present designation.)

Gonaspis ASHMEAD.

Psyche, vol. 8, 1897, p. 68. Two species.

Type.—*Diastrophus scutellaris* GILLETTE. (Original designation.)

Gonieucoela KIEFFER.

Entom. Zeitschr., vol. 21, 1907, p. 113.

Type.—*Gonieucoela bilobata* KIEFFER. (Monobasic.)

Gronotoma FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 342, 346. Two species.

Type.—*Gronotoma sculpturata* FÖRSTER. (Original designation.)

Hemicrisis FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 338, 339.

Type.—*Hemicrisis ruficornis* FÖRSTER. (Monobasic and original designation.)

Heptameris FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 342, 350.

Type.—*Eucocla pygmaca* DAHLBOM. (Monobasic and original designation.)

Heptamerocera ASHMEAD.

Proc. Zool. Soc. Lond., 1895, pp. 7, 60. Seven species.

Type.—*Heptamerocera robusta* ASHMEAD. (Original designation.) [Genotype placed in *Rhoptromeris* by Dalla Torre and Kieffer, 1910, p. 163.]

Heptaplasta KIEFFER.

Feuille Jeune Natural., vol. 31, 1901, p. 173. Two species.

Type.—*Heptamerocera alicna* ASHMEAD. (Designated by Ashmead, 1903, p. 67.)

(Heterobius GUÉRIN)=**Biorhiza** WESTWOOD.

Rev. Mag. Zool. (ser. 2), vol. 18, 1865, p. 138.

Type.—*Cynips aptera* Bosc. (Monobasic, as *Cynips aptera* Bosc is the same as *aptera* Fabricius. Isogenotypic with *Biorhiza* Westwood.

Heterocynips KIEFFER.

Boll. Soc. Ent. Ital., vol. 41, 1909, pp. 247 and 252.

Type.—*Heterocynips rufipes* KIEFFER. (Monobasic.)

Hexacharis KIEFFER.

Entomol. Zeitschr., vol. 21, 1907, p. 142.

Type.—*Hexacharis flavipes* KIEFFER. (Monobasic.)

Hexacola FÖRSTER. (=**Hexaplasta** FÖRSTER.)

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, p. 342, 349.

Type.—*Eucocla picicrus* GIRAUD. (Monobasic and original designation.) [*Kleidotoma hexatoma* Thomson was chosen by Ashmead, 1903, p. 62, as the type of *Hexacola* and is apparently the species which Förster had under the name *Eucocla picicrus* Giraud, but this can not be used as the type, because Förster definitely chose *Eucocla picicrus* Giraud and not *Eucocla picicrus*, as determined by himself. *Hexacola* of Förster's description and of subsequent authors is to be known as *Kleidotomidea*, which see.]

Hexamerocera KIEFFER.

Feuille Jeune Natural., vol. 31, 1901, p. 175. Fifteen species.

Type.—*Eucocla rufiventris* GIRAUD. (Designated by Ashmead, 1903, p. 66.)

(Hexaplasta FÖRSTER)=**Hexacola** FÖRSTER, genotype, not description.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 345, 359. Two species.

Type.—*Cothonaspis hexatoma* HARTIG. (Original designation.) [*C. hexatoma* Hartig is, according to Das Tierreich, p. 114, congeneric with *Eucocla picicrus* Giraud, the genotype of *Hexacola* Förster.]

(Holcaspis MAYR, not CHAUDOIR, 1850–, Col.)=**Disholcaspis** DALLA TORRE and KIEFFER.

20 Jahresber. Comm. Oberrealsch. I. Bez. Wien, 1881, p. 35. Three species.

Type.—*Cynips quercus-globulus* FITCH. (Designated by Ashmead, 1903, p. 153.)

Holocynips KIEFFER.
Boll. Lab. Portici, vol. 4, 1910, p. 114.
Type.—*Holocynips emarginata* KIEFFER. (Monobasic.)

(**Holocynips** KIEFFER, 1916, not 1910)=**Diholocynips**, new name.
Phil. Journ. Sci., vol. 11, 1916, p. 284–5.
Type.—*Holocynips nigra* KIEFFER. (Original designation and monobasic.)

Hololexis FÖRSTER.
Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 330, 333.
Type.—*Hololexis rufipes* FÖRSTER. (Monobasic and original designation.)
[Genotype placed in *Rhodites* by Dalla Torre and Kieffer, 1910, p. 714.]

Homorus FÖRSTER.
Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 363, 366.
Type.—*Figites abnormis* GIRAUD. (Monobasic and original designation.)
[Genotype placed in *Figites* by Dalla Torre and Kieffer, 1910, p. 83.]

Hypodiranchus ASHMEAD.
Fauna Hawaiiensis, vol. 1, 1901, p. 303. Two species.
Type.—*Hypodiranchis hawaiiensis* ASHMEAD. (Designated by Ashmead, 1903, p. 67.)

Hypolethria FÖRSTER.
Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 343, 355.
Type.—*Cothonaspis melanoptera* HARTIG. (Monobasic and original designation.)

Ibalia LATREILLE=(**Sagaris** PANZER).
Hist. Nat. Crust. et Insect., vol. 3, 1802, p. 306.
Type.—(*Ophion cultellator* FABRICIUS.) (Monobasic.) =*Ichneumon leucospoides* HOCHENWARTH. Isogenotypic with *Sagaris* Panzer.

Idiomorpha FÖRSTER.
Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 343, 353.
Type.—*Idiomorpha melanocera* FÖRSTER. (Monobasic and original designation.)

Isocolus FÖRSTER=(**Eubothrus** FÖRSTER).
Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 330, 334.
Type.—*Diastrophus scabiosae* GIRAUD. (Monobasic and original designation.) [Genotype placed in *Aylax* by Dalla Torre and Kieffer, 1910, p. 65]. Isogenotypic with *Eubothrus* Förster.

(**Kiefferia** ASHMEAD, not MIK, 1895)=**Kiefferiella** ASHMEAD.
Psyche, vol. 10, 1903, p. 10.
Type.—*Kiefferia rugosa* ASHMEAD. (Original designation.)

Kiefferiella ASHMEAD=(**Kiefferia** ASHMEAD, not MIK).
Proc. Ent. Soc. Wash., vol. 5, 1903, p. 221.
Type.—*Kiefferia rugosa* ASHMEAD. (Monobasic and original designation.)

Kleidotoma WESTWOOD.
Magaz. Nat. Hist., vol. 6, 1833, p. 494.
Type.—*Kleidotoma psilöides* WESTWOOD. (Monobasic.)

Kleidotomidea, new name. (=Hexacola FÖRSTER description and Authors, but not of Genotype.)
Type.—*Kleidotoma hexatoma* THOMSON. See Remarks under *Hexacola* and *Hexaplasta*.

Lambertonia KIEFFER.
Bull. Soc. Ent. France, 1901, pp. 158, 159. Three species.
Type.—*Lambertonia abnormis* KIEFFER. (Designated by Ashmead, 1903, p. 215.)

Leptopilina FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 342, 348.

Type.—*Cothonaspis longipes* HARTIG. (Monobasic and original designation.)

Liebelia KIEFFER.

Bull. Soc. Ent. France, 1903, p. 31. No species.

Zeitschr. Hym. Dipt., vol. 3, 1903, p. 110. Redescribed as new genus and species.

Type.—*Liebelia cavarae* KIEFFER. (Monobasic.)

Liodora FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 331, 334.

Type.—*Liodora sulcata* FÖRSTER. (Monobasic and original designation.) [Genotype placed in *Diplolepis* by Dalla Torre and Kieffer, 1910, p. 342.]

Liopteron PERTY.

Delect. anim. artic. Brazil, 1833, p. 140.

Type.—*Liopteron compressum* PERTY. (Monobasic.)

Liposthenes FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 331, 336.

Type.—(*Aulax glechomae* HARTIG.) (Monobasic and original designation.) =*Aulax latreillei* KIEFFER.

In designating *glechomae* as the type of *Liposthenes*, Förster fortunately chose to follow the interpretation of this species as used by Hartig, which has been renamed *latreillei* by Kieffer, which makes it possible to use this name as Förster's characters indicate he intended it should be used, but Dalla Torre and Kieffer, 1910, p. 668, have placed the genotype in *Aulax*.

Lonchidia THOMSON.

Ofvers. Svensk. Vet.-Akad. Förh., vol. 18, 1861, p. 413. Three species.

Type.—*Figites maculipennis* DAHLBOM. (Designated by Förster, 1869, p. 364.)

Loxaulus MAYR.

20 Jahresber. Comm. Oberrealsch. I, Bez. Wien, 1881, pp. 8, 12, 33.

Type.—*Cynips quercus-mammula* BASSETT. (Monobasic.)

Lytorhodites KIEFFER.

Bull. Soc. Hist. Nat. Metz, (2) vol. 10, p. 96. Six species.

Type.—*Rhodites arcfactus* GILLETTE. (Present designation.)

Lytosema KIEFFER.

Feuille Jeunes Natural, vol. 31, 1901, p. 162. Three species.

Type.—*Eucoela gucrini* DAHLBOM. (Designated by Ashmead, 1903, p. 67.)

Lytoxysta KIEFFER.

Nat. Zeitschr. Forst.-Landw. Jahrg. 7, 1909, p. 479. One species, one variety.

Type.—*Lytoxysta brevipalpis* KIEFFER. (Present designation.)

Macrocereucoila ASHMEAD.

Trans. Amer. Ent. Soc., vol. 14, 1887, p. 153.

Type.—*Macrocereucoila longicornis* ASHMEAD. (Monobasic.)

Manderstjernia RADOSZKOWSKI.

Bull. Soc., natural. Moscou, vol. 39, 1866, p. 304.

Type.—(*Manderstjernia paradoxa* RADOSZKOWSKI.) (Monobasic.) =*Cynips albopunctata* SCHLECHTENDAL. [Genotype placed in *Andricus* by Dalla Torre and Kieffer, 1910, p. 490.]

Megapelmus HARTIG.

Zeitschr. f. Entom., vol. 2, (1839) 1840, p. 186.

Type.—(*Megapelmus sphecciformis* HARTIG.) (Monobasic.)=*Anacharis typica* WALKER. [Type.—*Megapelmus ensifer* Walker. (Designated by Förster, 1869, p. 361.)] [Genotype placed in *Anacharis* by Dalla Torre and Kieffer, 1910, p. 38.]

Melanips (WALKER) GIRAUD=(**Amblynotus** HARTIG).

WALKER, Entom. Magaz., vol. 3, 1835, p. 161. No species. GIRAUD, Verh. Zool.-Bot. Ges. Wien, vol. 10, 1860, p. 163. Seven species.

Type.—*Scytodes opacus* HARTIG. (Designated by Förster, 1869, p. 367.) Isogenotypic with *Amblynotus* Hartig.

Mesocynips CAMERON.

Journ. Royal Asiat. Soc., 1903, p. 91.

Type.—*Mesocynips insignis* CAMERON. (Monobasic.)

Microstilba FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 342, 346. Three species.

Type.—*Microstilba bidentata* FÖRSTER. (Original designation.)

Miomoera FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 343, 352.

Type.—*Mioneetis aberrans* FÖRSTER. (Monobasic and original designation.)

Miteucoela KIEFFER.

Entom. Zeitschr., vol. 21, 1907, p. 113. Four species.

Type.—*Miteucoela nigriceps* KIEFFER. (Present designation.)

Moneucoela DALLA TORRE and KIEFFER.

Das Tierreich, 1910, p. 103. Two species.

Type.—*Diranchis grenadensis* ASHMEAD. (Present designation.)

Nedinoptera FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 343, 350.

Type.—*Kleidotoma halophila* THOMSON. (Monobasic and original designation.)

Nephycta FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 338, 339.

Type.—*Nephycta discreta* FÖRSTER. (Monobasic and original description.)

Neralsia CAMERON.

Biol. Centr.-Amer., P. 27, Hymen. I, 1883, p. 74.

Type.—*Neralsia rufipes* CAMERON. (Monobasic.)

Nesodiranchis PERKINS.

Fauna Hawaiiensis, Hym. Suppl., 1910, p. 668.

Type.—*Cothonaspis* (*Nesodiranchis*) *ashmeadi* PERKINS. (Monobasic.)

Neuroterus HARTIG=(**Ameristus** FÖRSTER).

Zeitschr. f. Entom., vol. 2 (1839), 1840, pp. 185, 192. Five species.

Type.—*Neuroterus politus* HARTIG. (Designated by Beutenmüller, 1910.) Isogenotypic with *Ameristus* Förster.

Oberthürella SAUSSURE.

Hist. Madagascar, vol. 20, pl. 20, fig. 8, 1890.

Type.—*Oberthürella lenticularis* SAUSSURE. (Monobasic.)

Odonteucoila ASHMEAD.

Proc. Ent. Soc. Wash., vol. 5, 1903, p. 222.

Type.—*Odonteucoila chapadae* ASHMEAD. (Monobasic.)

Odontocynips KIEFFER.

Boll. Lab. Portici, vol. 4, 1910, p. 112.

Type.—*Odontocynips nebulosa* KIEFFER. (Monobasic.)

Odontosema KIEFFER.

Bull. Soc. Hist. Nat. Metz, vol. 26, 1909, p. 58.

Type.—*Odontosema albinerve* KIEFFER. (Monobasic.)

Omalaspis GIRAUD.

Verh. Zool.-Bot. Ges. Wien, vol. 10, 1860, p. 155.

Type.—*Omalaspis noricus* GIRAUD. (Monobasic.)

[Type.—*Figites niger* Hartig, designated by Förster, 1869.]

Omalaspoides HEDICKE.

Entomol. Mitteilungen, vol. 2, 1913, p. 146. Two species.

Type.—*Omalaspoides letzneri* HEDICKE. (Original designation.)

Onychia (HALIDAY) WESTWOOD (not HÜBNER, 1816)=**Aspicera** DAHLBOM.

Magaz. Nat. Hist., vol. 6, 1833, p. 494.

Type.—(*Cynips cdiogaster* PANZER.) (Monobasic.)=*Aspicera scutellata* (VILLERS). Isogenotypic with *Aspicera* Dahlbom.

Panteliella KIEFFER.

ANDRE, 1902, Spec. Hym. Eur., Algeria, vol. 7, p. 324.

Type.—*Aulax fedtschenkoi* (RÜBSAAMEN). (Monobasic.)

Paramblynotus CAMERON.

The Entom., vol. 41, 1908, p. 299. Two species.

Type.—*Paramblynotus punctulatus* CAMERON. (Present designation.)

Paramiomoea ASHMEAD.

Trans. Zool. Soc. Lond., 1895, pp. 751, 774, 778.

Type.—*Paramiomoea heptatoma* ASHMEAD. (Monobasic.)

[Genotype placed in *Miomoera* Förster, by Dalla Torre and Kieffer, 1910, p. 133.)

Parandricus KIEFFER.

Marcellia, vol. 5, 1906, p. 102.

Type.—*Parandricus mairei* KIEFFER. (Monobasic.)

Paraspicera KIEFFER.

Ent. Zeitschr., vol. 21, 1907, p. 152.

Type.—*Paraspicera bakeri* KIEFFER. (Monobasic.)

Parateras ASHMEAD.

Can. Ent., vol. 29, 1897, p. 262.

Type.—*Parateras hubbardi* ASHMEAD. (Monobasic.)

Paraulax KIEFFER.

Bull. Soc. Nat. Metz, vol. 11, 1904, p. 59.

Type.—*Paraulax perplexus* KIEFFER. (Monobasic.)

Pediaspis TISCHBEIN=(**Bathyaspis** FÖRSTER).

Stettin. entom. Zeitg., vol. 13, 1852, p. 141.

Type.—*Pediaspis sorbi* TISCHBEIN. (Monobasic.)

Isogenotypic with *Bathyaspis* Förster through synonymy.

Pentacrita FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 342, 349. Four species.

Type.—*Cothonaspis retusa* HARTIG. (Original designation.)

[Type.—*Eucoela cordata* Giraud, designated by Ashmead, 1903, p. 62.]

Pentamerocera ASHMEAD.

Proc. Zool. Soc. Lond., 1895, p. 774. Seven species.

Type.—*Pentamerocera angularis* ASHMEAD. (Original designation.)

Pentaplasta KIEFFER.

Feuille Jeunes Natural., vol. 31, 1901, p. 160.

Type.—*Pentacrita coxalis* ASHMEAD. (Monobasic.)

Pentarhoptra KIEFFER.

Feuille Jeunes Natural., vol. 31, 1901, pp. 172, 173. Two species.

Type.—*Eucocla tomentosa* GIRAUD. (Designated by Ashmead, 1903, p. 68.)

Peras WESTWOOD.

Mag. de Zool., vol. 7, 1837, pl. 179, Classe IX.

Type.—*Peras nigra* WESTWOOD. (Monobasic.)

Periclistus FÖRSTER.

Verh. Zool.-Bot Ges. Wien, vol. 19, 1869, pp. 332, 337.

Type.—*Aulax caninae* HARTIG. (Monobasic and original designation.)

Pezophycta FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 338, 339.

Type.—*Xystus brachypterus* HARTIG. (Monobasic and original designation.)

Phaenoglyphis FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, p. 338.

Type.—*Phaenoglyphis xanthochroa* FÖRSTER. (Monobasic and original designation.)

Phanacis FÖRSTER.

Verh. naturh. Ver. preuss. Rheinl., vol. 17, 1860, p. 145.

Type.—*Phanacis centaureae* FÖRSTER. (Monobasic.)

Philonyx FITCH.

5th Report Insects of New York, 1859, p. 783. Two species.

Type.—*Philonyx fulvicollis* FITCH. (Designated by Ashmead, 1903, p. 148.) [Genotype placed in *Biorhiza* by Dalla Torre and Kieffer, 1910, p. 402.]

Phylloteras ASHMEAD.

Psyche, vol. 8, 1897, p. 67.

Type.—*Biorhiza rubinus* GILLETTE. (Monobasic and original designation.) [Genotype placed in *Trigonaspis* by Dalla Torre and Kieffer, 1910, p. 393.]

Piezobria FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 344, 358.

Type.—*Piezobria bicuspidata* FÖRSTER. (Monobasic and original designation.)

Pilinothrix FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 345, 358. Two species.

Type.—*Pilinothrix designata* FÖRSTER. (Original designation.)

Plagiotrochus MAYR.

20 Jahresber. Comm. Oberrealsch. I, Bez. Wien, 1881, pp. 8, 12. Two species.

Type.—*Cynips quercus-ilicis* FABRICIUS. (Designated by Ashmead, 1903, p. 151.)

Plastibalia KIEFFER.

Boll. Soc. Ent. Ital., vol. 41, 1909, pp. 246 and 249.

Type.—*Plastibalia violaceipennis* KIEFFER. (Monobasic.)

Poncyia KIEFFER.

Marcellia, vol. 2, 1903, p. 86.

Type.—*Poncyia ferruginea* KIEFFER. (Monobasic.)

Promiomera ASHMEAD.

Proc. Ent. Soc. Wash., vol. 5, 1903, p. 221.

Type.—*Promiomera filicornis* ASHMEAD. (Monobasic and original designation.)

Prosaspicera KIEFFER.

Ent. Zeitschr., vol. 21, 1907, p. 153. Two species.

Type.—*Prosaspicera ensifera* KIEFFER. (Present designation.)

Prosynapsis DALLA TORRE and KIEFFER=(Synapsis FÖRSTER, 1869, not BATES, 1868).

Das Tierreich, 1910, p. 45.

Type.—*Synapsis aquisgranensis* FÖRSTER. (A new name takes same species for type.)

Protoibalia BRUES.

Bull. Mus. Comp. Zool., vol. 54, 1910, p. 15.

Type.—*Protoibalia connexiva* BRUES. (Original designation and monobasic.)

Pseudeucoila ASHMEAD.

Proc. Ent. Soc. Wash., vol. 5, 1903, p. 222.

Type.—*Eucoela* (*Cothonaspis*) *trichopsila* HARTIG. (Monobasic and original designation.)

Pseudibalia KIEFFER.

Boll. Soc. Ent. Ital., vol. 41, 1909, pp. 246 and 247.

Type.—*Pseudibalia fasciatipennis* KIEFFER. (Monobasic.)

Psichacra FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 344, 356.

Type.—*Cothonaspis longicornis* HARTIG. (Monobasic and original designation.)

Psilodora FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 348, 354. Two species.

Type.—*Cothonaspis boyenii* HARTIG. (Original designation.)

Psilodoropsis HEDICKE.

Deutsch. Ent. Zeitschr., 1913, p. 443.

Type.—*Psilodoropsis conradti* HEDICKE. (Original designation and monobasic.)

Psilogaster HARTIG.

Zeitschr. f. Entom., vol. 2, (1839) 1840, p. 187. Three species.

Type.—*Psilogaster anthyomyiarum* HARTIG. (Present designation.) [Genotype placed in *Figites* by Dalla Torre and Kieffer, 1910, p. 87.]

Psilosema KIEFFER.

Feuille Jeunes Natural, vol. 31, 1901, p. 160. Seven species.

Type.—*Psilosema giraudi* DALLA TORRE and KIEFFER. (Present designation.) (=*Cothonaspis pentatoma* GIRAUD and THOMSON, not HARTIG.) Inasmuch as it is doubtful that Ashmead's designation, 1903, p. 62, of *Cothonaspis pentatoma* Thomson as the type of *Psilosema* is valid, because *C. pentatoma* Thomson was not included, we designate as the type of *Psilosema*, *Cothonaspis pentatoma* Giraud, which is the same as *C. pentatoma* Thomson. The *C. pentatoma* Giraud is different from *C. pentatoma* Hartig, and has been renamed *giraudi* by Dalla Torre and Kieffer.

Pycnostigmus CAMERON.

Ann. Mag. Nat. Hist. (7), vol. 21, 1905, p. 20.

Type.—*Pycnostigmus rostratus* CAMERON. (Monobasic.)

Pycnotrichia FÖRSTER.

Verh. Zool.—Bot. Ges. Wien, vol. 19, 1869, pp. 363, 366. Three species.

Type.—*Pycnotrichia erythropa* FÖRSTER. (Original designation.) [Type.—*Figites urticarum* Dahlbom, designated by Ashmead, 1903, p. 10.] [Genotype placed in *Figites* by Dalla Torre and Kieffer, 1910, p. 86.]

Rhabdeucoela KIEFFER.

Entom. Zeitschr., vol. 21, 1907, p. 70. Six species.

Type.—*Rhabdeucoela nitidifrons* KIEFFER. (Original designation.)

(Rhodites HARTIG)=**Diplolepis** GEOFFROY.

Zeitschr. f. Entom., vol. 2, (1839) 1840, p. 186. Three species.

Type.—*Cynips rosae* LINNAEUS. (Designated by Förster, 1869, p. 332.) Isogenotypic with *Diplolepis* Geoffroy.

Rhoophilus MAYR.

20 Jahresber. Comm. Oberrealsch. I, Bez. Wien, 1881, p. 6, 11, 22.

Type.—*Rhoophilus loewi* MAYR. (Monobasic.)

Rhoptromeris FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 344, 356. Six species.

Type.—*Cothonaspis euccra* HARTIG. (Original designation.)

Rhynchacis FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 342, 349.

Type.—*Cothonaspis nigra* HARTIG. (Monobasic and original designation.)

(Sagaris PANZER)=**Ibalia** LATREILLE.

Krit. Revis., vol. 2, 1806, p. 91.

Type.—(*Ophion cultellator* FABRICIUS). (Monobasic.) =*Ichneumon leucospoides* HOCHENWARTH.

Isogenotypic with *Ibalia* Latreille.

Sapholytus FÖRSTER.

Verh. Zool.—Bot. Ges. Wien, vol. 19, 1869, pp. 332, 337.

Type.—*Synergus apicalis* HARTIG. (Monobasic and original designation.) [Genotype placed in *Synergus* by Dalla Torre and Kieffer, 1910, p. 608.]

Saphonecrus DALLA TORRE and KIEFFER.

Das Tierreich, 1910, p. 605. Six species.

Type.—*Synergus connatus* HARTIG. (Original designation.)

Sarothrus HARTIG.

Zeitschr. f. Entom., vol. 2, (1839), 1840, p. 187. Three species.

Type.—(*Sarothrus canaliculatus* HARTIG.) (Designated by Förster, 1869, p. 367)=*Cynips tibialis* ZETTERSTEDT teste Dalla Torre and Kieffer, 1910, p. 75. [Type.—*Sarothrus arcolatus* Hartig, designated by Ashmead, 1903, p. 9.]

Schizosema KIEFFER.

Feuille Jeunes Natural., vol. 31, 1901, p. 161. Two species.

Type.—*Eucoela emarginatus* HARTIG. (Designated by Ashmead, 1903, p. 62.)

(Scytodes HARTIG, not WALCKENAER, 1805)=**Melanips** (WALKER) GIRAUD.

Zeitschr. f. Entom., vol. 2 (1839), 1840, p. 187. Two species.

Type.—*Scytodes opacus* HARTIG. (Present designation.)

(Solenaspis ASHMEAD, not OSTEN-SACKEN, 1881, in Diptera)=**Xyalosema** DALLA TORRE and KIEFFER.

Trans. Amer. Ent. Soc., vol. 14, 1887, p. 155.

Type.—*Solenaspis hyalinipennis* ASHMEAD. (Monobasic.)

Solenozopheria ASHMEAD.

Trans. Amer. Ent. Soc., vol. 14, 1887, p. 149.

Type.—*Solenozopheria vaccinii* ASHMEAD. (Monobasic.)

Spathegaster HARTIG.

Zeitschr. f. Entom., vol. 2 (1839), 1840, p. 186.

Type.—*Spathegaster petioliventris* HARTIG. (Monobasic.) [Genotype placed in *Neuroterus* by Dalla Torre and Kieffer, 1910, p. 327.]

Sphaeroteras ASHMEAD.

Psyche, vol. 8, 1897, p. 67.

Type.—*Biorhiza mellea* ASHMEAD. (Monobasic and original designation.) [Genotype placed in *Biorhiza* by Dalla Torre and Kieffer, 1910, p. 398.]

Steleucoela KIEFFER.

Ann. Soc. Sci. Brux., vol. 32, 1908, p. 48.

Type.—*Steleucoela piriformis* KIEFFER. (Monobasic.)

Stirencoela CAMERON.

The Entom., vol. 43, 1910, p. 180.

Type.—*Stirencoela striaticollis* CAMERON. (Monobasic.)

(**Synapsis** FÖRSTER, not BATES, 1868) = **Prosynapsis** DALLA TORRE and KIEFFER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, p. 361.

Type.—*Synapsis aquisgranensis* FÖRSTER. (Monobasic and original designation.)

Synergus HARTIG.

Zeitschr. f. Entom., vol. 2 (1839), 1840, p. 186. Fourteen species.

Type.—*Synergus vulgaris* HARTIG. (Designated by Förster, 1869, p. 338.)

Synophromorpha ASHMEAD.

Psyche, vol. 10, 1903, p. 145.

Type.—*Synophromorpha salicis* ASHMEAD. (Monobasic and original designation.)

Synophrus HARTIG.

Zeitschr. f. Entom., vol. 4, 1843, p. 411.

Type.—*Synophrus politus* HARTIG. (Monobasic.)

Tavaresia KIEFFER.

Bull. Soc. Ent. France, 1901, pp. 158, 160. Five species.

Type.—*Tavaresia carinata* KIEFFER. (Designated by Ashmead, 1903, p. 215.)

(**Teras** HARTIG, not TREITSCHKE, 1829) = **Dryoteras** FÖRSTER.

Zeitschr. f. Entom., vol. 2 (1839), 1840, p. 185.

Type.—(*Teras terminalis* FABRICIUS.) (Monobasic.) = *Diplolepis pallida* OLIVIER. teste Dalla Torre and Kieffer, 1910, p. 398.

Tessmannella HEDICKE.

Deutsch. Ent. Zeitschr., 1912, p. 303. Two species.

Type.—*Tessmannella spinosa* HEDICKE. (Original designation.)

Tetramerocera ASHMEAD.

Trans. Zool. Soc. Lond., 1895, p. 778.

Type.—*Tetramerocera variabilis* ASHMEAD. (Monobasic and original designation.)

Tetraplasta ASHMEAD.

Psyche, 1903, p. 68.

Type.—*Tetraplasta unica* ASHMEAD. (Original designation.)

Tetrarhoptra FÖRSTER.

Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 342, 349. Two species.

Type.—*Cliditoma heterotoma* THOMSON. (Original designation.) [Type.—*Tetrarhoptra tetratoma* Förster, designated by Ashmead, 1903, p 62.]

(**Tetratoma** CAMERON, not FABRICIUS) = **Tetrarhoptra** FÖRSTER.

Monogr. Brit. Phytoph. Hymen., vol. 3, 1890, p. 223. Four species.

Type.—*Kleditoma heterotoma* THOMSON. (Present designation.) Isogenotypic with *Tetrarhoptra* Förster.

Thyreocera ASHMEAD.

Trans. Amer. Ent. Soc., vol. 14, 1887, p. 154.

Type.—(*Thyreocera nigrifemora* ASHMEAD.) (Monobasic.) = (*Figites*) *Thyreocera laeviscutum* PROVANCHER, teste Ashmead, 1903, p. 10.

Timaspis MAYR.

20 Jahresber. Comm. Oberrealsch. I Bez. Wien, 1881, p. 18.

Type.—*Timaspis lampsanae* (PERRIS) KARSCH. (Monobasic.) [Type.—*Timaspis phaenixopodus* Mayr, designated by Ashmead, 1903, p. 214.]

Tribalia WALSH.
Proc. Ent. Soc. Phila., vol. 2, 1864, p. 470.
Type.—*Tribalia batatorum* WALSH. (Monobasic.)

Trichagalma MAYR.
Marcellia, vol. 6, 1907, p. 3.
Type.—*Trichagalma drouardi* MAYR. (Monobasic.)

Trichoteras ASHMEAD.
Psyche, vol. 8, 1897, p. 67.
Type.—*Trichoteras coquilletti* ASHMEAD. (Monobasic.)

Trigonaspis HARTIG.
Zeitschr. f. Entom., vol. 2 (1839), 1840, p. 186.
Type.—(*Trigonaspis crustalis* HARTIG.) (Monobasic.)=(*Cynips*) *Trigonaspis megaptera* PANZER.

Triplasta KIEFFER.
Feuille Jeunes Natural., vol. 31, 1901, p. 160. Three species.
Type.—*Kleidotoma atrocoxalis* ASHMEAD. (Designated by Ashmead, 1903, p. 61.)

Trirhoptrasema KIEFFER.
Bull. Soc. Ent. France, 1901, p. 344.
Type.—(*Klcidotoma americana* ASHMEAD.) (Monobasic.)=(*Kleidotoma*) *Trirhoptrasema ashmeadi*, new name.[1]

Trischiza FÖRSTER.
Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 364, 367.
Type.—*Figites agaricolarum* DAHLBOM. (Monobasic and original designation.)

(**Trisolenia** ASHMEAD, not EHRENBERG, 1861)=**Trisoleniella**, new name.
Trans. Amer. Ent. Soc., vol. 14, 1887, p. 142.
Type.—*Andricus* (*Trisolenia*) *saltatus* ASHMEAD. (Monobasic.) [Genotype placed in *Andricus* by Dalla Torre and Kieffer, 1910, p. 453.]

Trisoleniella, new name=(**Trisolenia** ASHMEAD, 1887, not EHRENBERG, 1861).
Type.—*Andricus* (*Trisolenia*) *saltatus* ASHMEAD.

Trissandricus KIEFFER.
Boll. Lab. Portici, vol. 4, 1910, p. 115.
Type.—*Trissandricus maculipennis* KIEFFER. (Monobasic.)

Trisseucoela KIEFFER.
Entomol. Zeitschr., vol. 21, 1907, p. 92. Three species.
Type.—*Trisseucoela fulvotincta* KIEFFER. (Present designation.)

Trissodontaspis ASHMEAD.
Proc. Ent. Soc. Wash., vol. 5, 1903, p. 222.
Type.—*Trissodontaspis rufipes* ASHMEAD. (Monobasic and original designation.)

Tropideucoila ASHMEAD.
Proc. Ent. Soc. Wash., vol. 5, 1903, p. 221.
Type.—*Tropideucoila rufipes* ASHMEAD. (Monobasic and original designation.)

Trybliographa FÖRSTER.
Verh. Zool. Bot. Ges. Wien, vol. 19, 1869, p. 359. Ten species.
Type.—*Cothonaspis scutellaris* HARTIG. (Original designation.) [Genotype placed in *Cothonaspis* by Dalla Torre and Kieffer, 1910, p. 125, as a species without a name.]

[1] Since *Coptercucoela* Ashmead is a synonym of *Kleidotoma*, *Kleidotoma americana* Ashmead, 1887, Trans. Amer. Ent. Soc., vol. 14, p. 152, line 6, needs a new name, being preoccupied by (*Coptercucoela*) *Kleidotoma americana* Ashmead, same reference top line. For this we propose *ashmeadi*. (Kieffer, 1901, Feuille Jeunes Natural., vol. 31, p. 161, erroneously renames (*Coptercucoela*) *Kleidotoma americana* Ashmead 1887, Trans. Amer Ent. Soc., vol. 14, p. 152, top line, as *ashmeadi*).

Tylosema KIEFFER.
Bull. Soc. Nat. Metz, vol. 12, 1905, p. 112.
Type.—*Tylosema nigerrimus* KIEFFER. (Monobasic and original designation.)

Xanthoteras ASHMEAD.
Can. Ent., vol. 29, 1897, p. 262.
Type.—*Biorhiza forticornis* WALSH. (Monobasic and original designation.)

Xenocynips KIEFFER.
Boll. Lab. Zool. Portici, vol. 4, 1910, p. 340.
Type.—*Xenocynips subsquamata* KIEFFER. (Monobasic.)

Xestophanes FÖRSTER.
Verh. Zool.-Bot. Ges. Wien, vol. 19, 1869, pp. 332, 337.
Type.—*Cynips potentillae* DE VILLERS. (Monobasic and original designation.)

Xyalaspis HARTIG.
Zeitschr. f. Entom., vol. 4, 1843, p. 416.
Type.—*Xyalaspis laevigatus* HARTIG. (Monobasic.)
[Type.—*Cynips nitidula* Dalman, designated by Ashmead, 1903, p. 12.]

Xyalophora KIEFFER.
Bull. Soc. Ent. France, 1901, p. 344. Three species.
Type.—*Figites clavatus* GIRAUD. (Original designation.)

Xyalosema DALLA TORRE and KIEFFER (=**Solenaspis** ASHMEAD, not OSTEN-SACKEN, 1881.)
Das Tierreich, 1910, p. 94.
Type.—*Solenaspis hyalinipennis* ASHMEAD. (A new name takes same type.)

Xystoteras ASHMEAD.
Can. Ent., vol. 29, 1897, p. 260.
Type.—*Xystoteras volutellae* ASHMEAD. (Monobasic.)

(**Xystus** HARTIG, not SCHÖNHERR, 1826)=**Charips** HALIDAY.
Zeitschr. f. Entom., vol. 2 (1839), 1840, p. 186. Ten species.
Type.—*Xystus erythrocephalus* HARTIG. (Present designation.)

Zaeucoila ASHMEAD.
Proc. Ent. Soc. Wash., vol. 5, 1903, p. 222.
Type.—*Zaeucoila unicarinata* ASHMEAD. (Monobasic and original designation.)

Zamischus ASHMEAD.
Proc. Ent. Soc. Wash., vol. 5, 1903, p. 221.
Type.—*Zamischus brasiliensis* ASHMEAD. (Monobasic and original designation.)

Zopheroteras ASHMEAD.
Can. Ent., vol. 29, 1897, p. 261.
Type.—*Aeraspis vaccinii* ASHMEAD. (Monobasic.) [Genotype placed in *Trigonaspis* by Dalla Torre and Kieffer, 1910, p. 393.]

Zygosis FÖRSTER.
Verh. Zool. Bot. Ges. Wien, vol. 19, 1869, pp. 363, 365.
Type.—*Psilogaster heteropterus* HARTIG. (Monobasic and original designation.)

In the preceding pages the following new generic and specific names, which should be accredited to Rohwer and Fagan, are proposed:

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NEW AND LITTLE-KNOWN SPECIES OF SOUTH AMERICAN FRESH-WATER MUSSELS OF THE GENUS DIPLODON.

By William B. Marshall,

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The new *Diplodon* herein described under the name *felipponei* was received in 1915 from Dr. Florentino Felippone, of Montevideo, Uruguay. The one described under the name *fortis* was received from the same donor about three years ago and has been in the collection of the United States National Museum under the name of *D. delodontus*.

Illustrations are given of six other species of *Diplodon* described by Mr. C. T. Simpson from material in the collection of the United States National Museum. Hitherto these species have not been figured.

DIPLODON FELIPPONEI, new species.

Plate 50, figs. 1–3; plate 51, fig. 1.

Shell thick, heavy and moderately swollen, elliptic in outline, valves greatly thickened in front. Gaping slightly front and back. Surface nearly evenly rounded and lacking a clearly defined posterior ridge. Anterior and posterior portions rounding up gently into the middle portion of the shell. Middle of the posterior area with a low, rounded, radial rib, other parts of shell obscurely radiately striated. On the middle portion the striae become more pronounced and partake of the nature of obsolete ribs. Rest periods about seven, indicated by a concentric elevating of the surface above the succeeding growth. Color light yellowish chestnut at the beaks, deepening regularly toward the margins, where it becomes dark chestnut. Periostracum shining, paper-like, tending to peel and curl at the posterior margin. Nacre silvery white, slightly iridescent at the posterior end, obsoletely thimble-pitted or granular. Anterior adductor scar deep, especially at its upper part, posterior adductor scar nearly superficial. Other muscle scars deeply punched. Pseudocardinal teeth large and heavy and much split up. Right valve with a large lateral tooth which is granular on both its surfaces. Left valve with two lateral teeth which are granular on their inner faces. Sinulus long, narrow, slightly bowed and ending in a sharp point.

The type, Cat. No. 322291, U.S.N.M., comes from Maldonado, Uruguay. It measures—length, 83 mm.; height, 59 mm.; diameter, 38 mm. It was donated to the United States National Museum by Dr. F. Felippone, of Montevideo, Uruguay, in whose honor I take pleasure in naming the species.

In richness and warmth of coloring, regularity of form and outline and in its appearance of exuberant health and prosperity this is one of the handsomest of the *Diplodons*. Externally it mimics some of the forms of *Anodontites wymani* and might pass for that shell if mixed in with a series of that species.

Its relationships point in two directions—namely, toward *D. rudus* Lea and *D. paranensis* Lea. Both of these species show the obsolete radiating ribs noted in the description of *felipponei*. From *D. rudus* it differs in outline, in not having a compressed posterior area and in being nearly straight instead of sinuate along the hinge line, and especially in the character of the pseudocardinals which, in *D. rudus*, are long and thin and placed parallel to the hinge line. From *D. paranensis* it can be distinguished at once by the elliptic outline, lack of the inflated ventral margin and by the character of pseudocardinals.

Another specimen of this same species is Cat. No. 180782, which measures—length, 77 mm.; height, 54 mm.; diameter, 31 mm. It comes from Arroyo Sarandi Grande, Uruguay, and was received from Mr. S. Olea. It is an exact duplicate of the type in every detail except size and state of preservation. The ratios of its length to height and to diameter are almost exactly the same as those of the type. This specimen has been in the collection since 1904 without specific name.

Since the above was written I have identified for Doctor Felippone five specimens of this species. One of these (his No. 593) from Arroyo Maciel, Florida, Uruguay, is, in some respects, superior to the type, especially in size. It measures—length, 94 mm.; height, 68 mm.; diameter, 40 mm. His numbers 606, 609, 610, and 611 each include a single valve in a poor state of preservation. They come from Rio Yi, Durazno, Uruguay.

DIPLODON FORTIS, new species.

Plate 52, figs. 1–4.

Shell thick, heavy, and much swollen. Outline elongately subquadrate, regularly rounded in front, prolonged into a blunt point behind, resembling in general form many specimens of *Unio tetralasmus* Say. Posterior dorsal ridge full, high, and rounded. A faint rib traverses the posterior area from the beak to a point just above the posterior angle. Ventral and dorsal margins nearly parallel. Surface with indistinct concentric fine lines, the rest periods indicated by dark lines. Anterior and middle portion with obscure radial sculpture. Color chestnut brown, darker posteriorly. Beaks eroded.

Nacre silvery white, tending to bluish white and iridescence posteriorly. Right valve with one small and one large pseudocardinal tooth, the latter grooved lengthwise; and a winglike lateral tooth. Left valve with a large anterior pseudocardinal, a deeply sunken linear mid-tooth, and a small posterior tooth. Lateral teeth of left valve two, very strong. Anterior muscle scars deeply impressed, posterior scars superficial. Anterior portion of shell much thickened, especially between the pallial line and the ventral margin. Shell gaping slightly front and back, enough to insert a slip of thick paper. Sinulus long, narrow, and pointed.

The type, Cat. No. 270899, U.S.N.M., measures—length, 66 mm.; height, 37 mm.; diameter, 27 mm. It comes from Rio Negro, Tacuarembo, Uruguay. It was presented to the museum several years ago by Dr. Florentino Felippone, and has been here under the name *delodontus* Lamarck. This species is related to *Diplodon charruanus* Orbigny, but is more nasute, having the ventral margin nearly straight and more nearly parallel to the dorsal margin. The pseudocardinal teeth of *charruanus* are largely divided into sharp points with corresponding sockets in the opposing teeth. Compared with these the teeth of *fortis* are much more simple. Authentic specimens of *charruanus*, from Orbigny show that its beaks are heavily sculptured and that this sculpture covers a considerable area. The beaks of *fortis* are eroded but the area eroded is less than the area sculptured in *charruanus*, and yet there is no indication of sculpture. From this it may be inferred that the sculptured area in *fortis* would be less than that in *charruanus*. Although of but moderate size, its compact, chunky form, its weight, and the thickening of the shelly matter, conveys an idea of strength and this has suggested the specific name *fortis*.

THE TYPES OF SIX LITTLE-KNOWN SPECIES OF SOUTH AMERICAN DIPLODON.

The following six species were described by Mr. Charles T. Simpson in A Descriptive Catalogue of the Naiades, or Pearly Fresh-water Mussels, published in 1914. His descriptions were based upon material in the collection of the United States National Museum, but no figures were given. The following descriptions and illustrations of the types will help more clearly to define the various species:

DIPLODON MIMUS Simpson.

Plate 51, figs. 3–6.

Diplodon minus Simpson, A Descriptive Catalogue of the Naiades or Pearly Fresh-water Mussels, 1914, p. 1249.

Shell small, solid, obliquely rhomboid, somewhat inflated along the posterior ridge, which is low, rounded, and widely biangulate.

Dorsal and ventral margins nearly parallel. Growth lines numerous, fine. Rest periods not sharply defined. Periostracum thin, closely adhering, slightly ruffled along the ventral margin, light chestnut in color, somewhat tawney in the center of the disk. Beaks much eroded. Pseudocardinals two in the right valve, the upper very small, the lower thick, high, and much crenulated. Pseudocardinals of left valve two, widely separated, the rear one small, the front one larger and much crenulated. Lateral tooth of right valve high, granulous. Lateral teeth of left valve subequal, crenulated. Nacre lurid, purplish-white, thickened in front.

The type (pl. 51, figs. 3–6) is one of two specimens of United States National Museum, Cat. No. 162425. It measures—length, 45 mm.; height, 27 mm.; diameter, 15 mm.; and comes from Iguape, Brazil, from Dr. H. von Ihering.

"A small, solid, rhomboid species which almost exactly mimics in external appearance some of the varieties of *Unio complanatus*."—Simpson.

DIPLODON PERPLEXUS Simpson.

Plate 52, fig. 5; plate 53, figs. 1–4.

Diplodon perplexus Simpson, A Descriptive Catalogue of the Naiades or Pearly Fresh-water Mussels, 1914, p. 1248.

Shell moderately thin, subrhomboidal, regularly rounded in front, obtusely pointed behind; posterior margin oblique. Ventral and dorsal margins subparallel. Posterior ridge low, rounded. Beaks but little elevated, located one-quarter of the length of the shell from the anterior margin. Surface of the shell with many fine growth lines. Rest periods feebly marked, except the last which is indicated by a dark line and a shallow groove. Periostracum thin, shining, closely adhering, olivaceous, darkening to chestnut anteriorly and posteriorly, slightly ruffled on the posterior dorsal area. Anterior half of shell with numerous, well-marked radiating striae. Nacre milky white and thickened anteriorly, moderately iridescent and thin posteriorly. Pseudocardinals of right valve unequal, the upper one small, the lower one three times as high, crenulated, set at an angle of about fifty degrees with the lateral. Pseudocardinal of right valve obliquely flattened and somewhat excavated, its upper margin sharply crenulated. Lateral tooth of right valve thin, high, slightly arcuate, its margin crenulated. Laterals of left valve two, the upper one low, the lower one high, the groove between them deep and narrow.

The type (pl. 53, figs. 1–4) is one of four specimens in the United States National Museum (Cat. No. 150389), and measures—length, 77 m.; height, 43 mm.; diameter, 26 mm. It comes from Lake Portrero, near Maldonado, Uruguay, and was collected and presented by Dr. William Rush, U. S. N. Four other specimens and

one odd valve (Cat. No. 150390 U.S.N.M.) were sent by Doctor Rush from the same place.

A lot of South American naiades just identified for Doctor Felippone includes 27 specimens of this species, of various ages, from localities in Uruguay. The two largest and oldest specimens measure, respectively—length, 91 mm.; height, 47 mm.; diameter, 27 mm.; and length, 86 mm.; height, 46 mm.; diameter, 29 mm. The old specimens retain all the typical characters, and vary from the younger specimens only in the thickening and enlarging of the pseudocardinal teeth. As is well known, a similar thicking and enlarging of these teeth is a common, almost a usual, occurrence in old specimens of the naiades in general.

DIPLODON SUPPOSITUS Simpson.

Plate 51, fig. 2; plate 54, figs. 1–4.

Diplodon suppositus SIMPSON, A Descriptive Catalogue of the Naiades or Pearly Fresh-water Mussels, 1914, p. 1245.
Diplodon piceus (part) SIMPSON, Synopsis, 1900, p. 877.

Shell moderately thin to subsolid, thinner posteriorly, slightly thickened anteriorly. Outline subrhomboidal, regularly rounded in front, bluntly round-pointed behind. Dorsal and ventral margins nearly parallel, the ventral margin slightly arcuate. Posterior dorsal ridge nearly wanting and, hence, the posterior dorsal area not distinctly marked off from the general surface of the shell. Beaks low, eroded in the type. Surface of shell with many poorly marked growth lines, obscurely showing four rest periods. Anterior portion with faint radial striae. Epidermis chestnut, bronzy. Nacre bluish white or livid, nearly dull anteriorly, brilliant posteriorly. Radiating striae show through the nacre at the posterior third. Pseudocardinals of right valve two, thin, parallel, set at an angle of about sixty degrees with the lateral. In the left valve the pseudocardinals are not sharply defined into two. Lateral teeth two in the left valve, one in the right valve.

The type (pl. 54, figs. 1–4) measures—length, 49 mm.; height, 26 mm.; diameter, 14 mm. It came from Parana, Brazil, and is one of four specimens bearing Cat. No. 162374, U.S.N.M.

Plate 51, fig. 2, represents the beak of this species, enlarged three diameters. The specimen figured comes from Rio Tiete, Brazil, and is one of three specimens in the United States National Museum (Cat. No. 128824). Both the specimens figured were received from Dr. H. von Ihering.

In addition to the specimens mentioned above the collection contains twelve other lots including 26 specimens, all from localities in Southern Brazil. All these were identified by Simpson as belonging to *D. suppositus*.

DIPLODON TRIVIALIS Simpson.

Plate 54, figs. 5–8.

Diplodon trivialis SIMPSON, A Descriptive Catalogue of the Naiades or Pearly Fresh-water Mussels, 1914, p. 1250.

Shell obovate, moderately inflated, subsolid, evenly rounded before and behind, narrower in front. Dorsal and ventral margins curving. Posterior ridge rounded, scarcely developed. Beaks moderately elevated, somewhat eroded, but showing that the sculpture consisted of about 20 radiating bars. Surface with a number of feebly marked growth lines, with four rest periods, indicated by dark lines. Faint indications of radiating striae on nearly the whole surface. Periostracum scarcely shining, clothlike, very dark olivaceous chestnut, closely adhering. Nacre bluish-white, somewhat iridescent, thickened along part of the ventral margin. Pseudocardinals of right valve parallel to each other, the upper one low, small and linear. The lower one thick, triangular, set at an angle of about 50 degrees with the lateral. Pseudocardinals of left valve distinctly two, subequal, set at an angle with each other. Lateral of right valve thin and high. Laterals of left valve subequal, the groove between them rather deep and wide.

The type (pl. 54, figs. 5–8), Cat. No. 162409, U.S.N.M., measures—length, 51 mm.; height, 33 mm.; diameter, 19 mm. It comes from Taboticabal, São Paulo, Brazil, and was received from Dr. H. von Ihering. Cat. No. 162406 includes two specimens and Cat. No. 162411 includes one specimen, all from the same source as the type. Cat. Nos. 125739, 162407, and 162408 each include one specimen from Piracicaba, São Paulo, Brazil, from Dr. von Ihering. Cat. No. 125703 includes one specimen from Rio Grande do Sul, São Paulo, Brazil. from Mr. B. H. Wright.

Mr. Simpson at first identified all of the above as *Diplodon peculiaris* Lea, but later came to the conclusion that they belonged to a new species. The collection contains the type of *peculiaris*, with which I have compared the type of *trivialis*, and I believe the two are distinct. Figure 6 shows the sculpture of the beaks. The rays are finer, more numerous, occupy a smaller area, and are more nearly parallel than those of *peculiaris*.

Two of the eight specimens in the collection have two lateral teeth in each valve. The other six specimens have a single lateral in the right valve and two laterals in the left valve.

DIPLODON SANTA MARIAE Simpson.

Plate 52, fig. 6; plate 55, figs. 1–4.

Diplodon santa mariae SIMPSON, A Descriptive Catalogue of the Naiades or Pearly Fresh-water Mussels, 1914, p. 1270.

Shell oblong, rhomboid, nearly twice as long as wide, moderately thin. Ventral and dorsal margins nearly parallel. Posterior ridge low, rounded, biangulate. Posterior margin biangulate. Beaks low,

much eroded. Surface with many fine lines of growth and with four rest periods indicated by dark lines. Numerous well-marked striae radiate from the beaks to the ventral margin. Periostracum dark brown, somewhat bronzy, scarcely shining, darker at the posterior end. Nacre livid in the upper portion, white below, brilliant posteriorly, thickened anteriorly, iridescently radiately striate. Pseudocardinals of right valve long, low, the upper the smaller, the groove between them slightly curved. Pseudocardinal of the left valve plate like, standing on a narrow shelf, thin at its upper end, thickened at the lower end. Lateral tooth of right valve long, low, and granulous. Laterals of the left valve nearly equal, the groove between them widening at the rear.

The type (pl. 55, figs. 1–4) is one of three specimens of Cat. No. 162383, U.S.N.M., from Rio Itapoca, Brazil, received from Dr. H. von Ihering. It measures—length, 63 mm., height, 33 mm., diameter 18 mm. Plate 52, figure 6, shows the beak (enlarged three diameters) of a specimen from the same locality and with the same catalogue number.

DIPLODON SEMIGRANOSUS Simpson.

Plate 55, figs. 5–8.

Diplodon semigranosus Simpson, A Descriptive Catalogue of the Naiades or Pearly Fresh-water Mussels, 1914, p. 1252.

Shell rather small, irregularly long elliptical, sharply rounded in front, somewhat nasute behind. Ventral margin regularly curved. Posterior ridge rounded, scarcely developed. Beaks apparently low, eroded, retaining vestiges of radial, somewhat granular, sculpture. Surface with feeble growth lines and three or four rest periods indicated by dark lines. Numerous faint, slightly granular striae radiate from the beaks, giving the surface a semigranulous appearance, especially anteriorly.

Periostracum thin, closely adhering, olivaceous, tinged with greenish, somewhat glossy. Nacre dirty bluish-white, thickened along the forward portion of the ventral margin, thin and iridescent posteriorly. Pseudocardinals of right valve moderately thick, parallel, the groove between them wide and deep. Pseudocardinal of left valve thin and plate-like. Lateral tooth of right valve moderately high. The upper lateral of the left valve low and weak, the lower one higher and moderately strong.

The type (pl. 55, figs. 5–8) is one of 11 specimens of Cat. No. 128790, U.S.N.M., from Rio Tiete, São Paulo, Brazil, from Dr. H. von Ihering. It measures—length, 47 mm.; height, 26 mm.; diameter, 15 mm.

Cat. No. 162414 includes two and No. 162415 one specimen from Ponte Grande, São Paulo, No. 162413 one specimen from Os Perus, São Paulo; No. 162412 six specimens from Ponta Grossa, Parana. All these localities are in southern Brazil and all the specimens were received from Dr. von Ihering.

EXPLANATION OF PLATES.

PLATE 50.

FIGS. 1–3. *Diplodon felipponei* Marshall. Natural size.

PLATE 51.

FIG. 1. *Diplodon felipponei* Marshall. Natural size.
2. *Diplodon suppositus* Simpson. Beak × 3.
3–6. *Diplodon mimus* Simpson. Natural size.

PLATE 52.

FIGS. 1–4. *Diplodon fortis* Marshall. Natural size.
5. *Diplodon perplexus* Simpson. Beak × 3.
6. *Diplodon santa mariae* Simpson. Beak × 3.

PLATE 53.

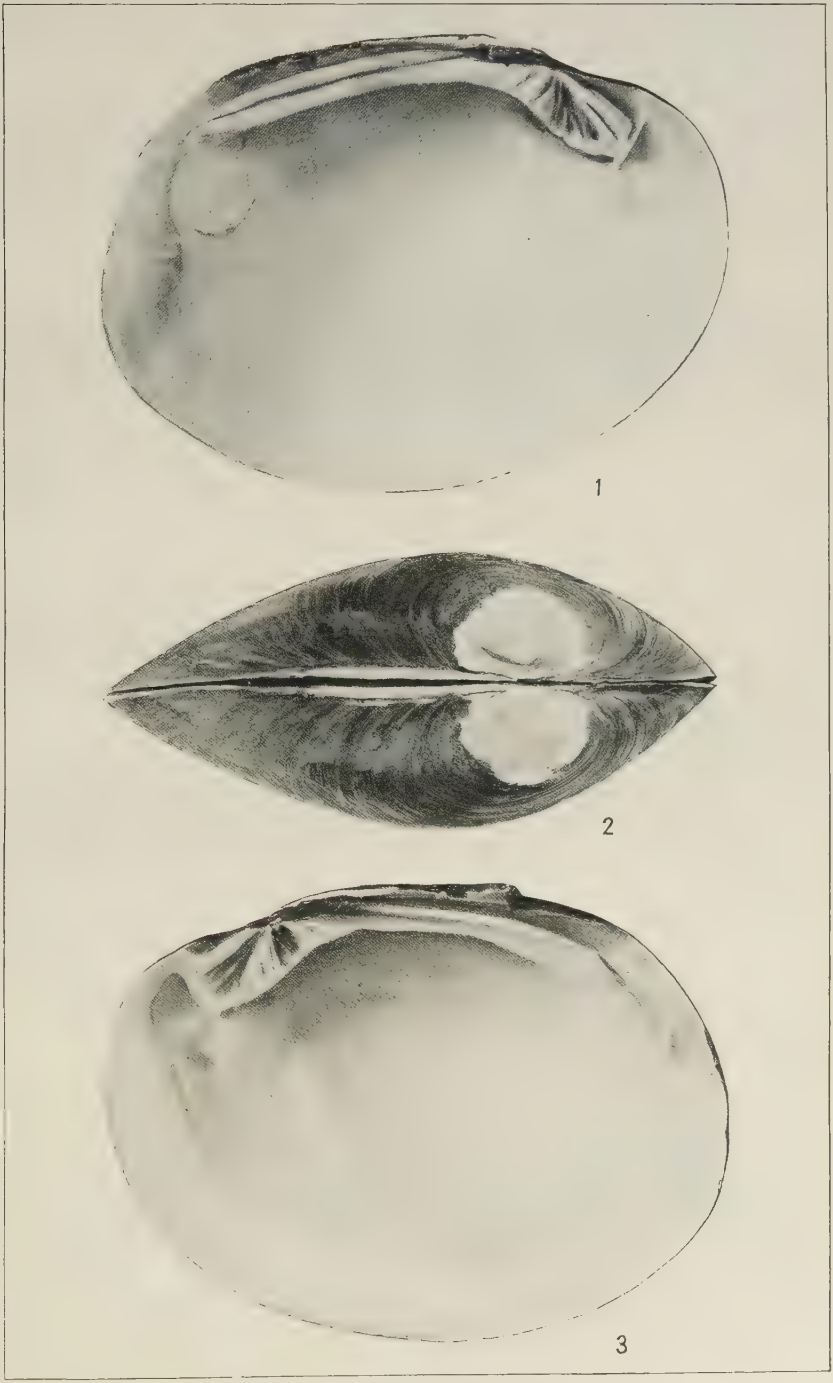
FIGS. 1–4. *Diplodon perplexus* Simpson. Natural size.

PLATE 54.

FIGS. 1–4. *Diplodon suppositus* Simpson. Natural size.
5–8. *Diplodon trivialis* Simpson. Natural size.

PLATE 55.

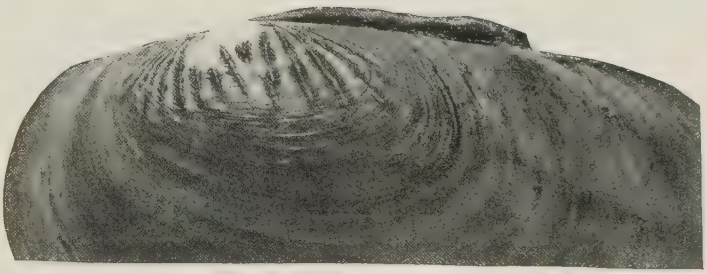
FIGS. 1–4. *Diplodon santa mariae* Simpson. Natural size.
5–8. *Diplodon semigranosus* Simpson. Natural size.



SOUTH AMERICAN DIPLODONS.

FOR EXPLANATION OF PLATE SEE PAGE 388.

1



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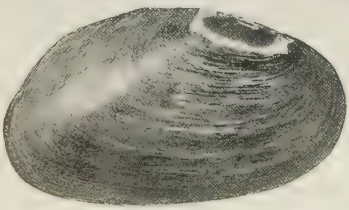

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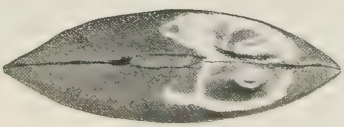

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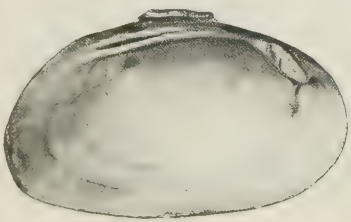

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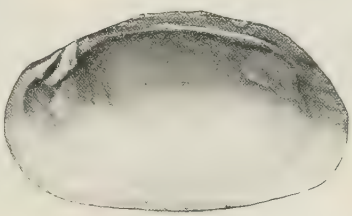

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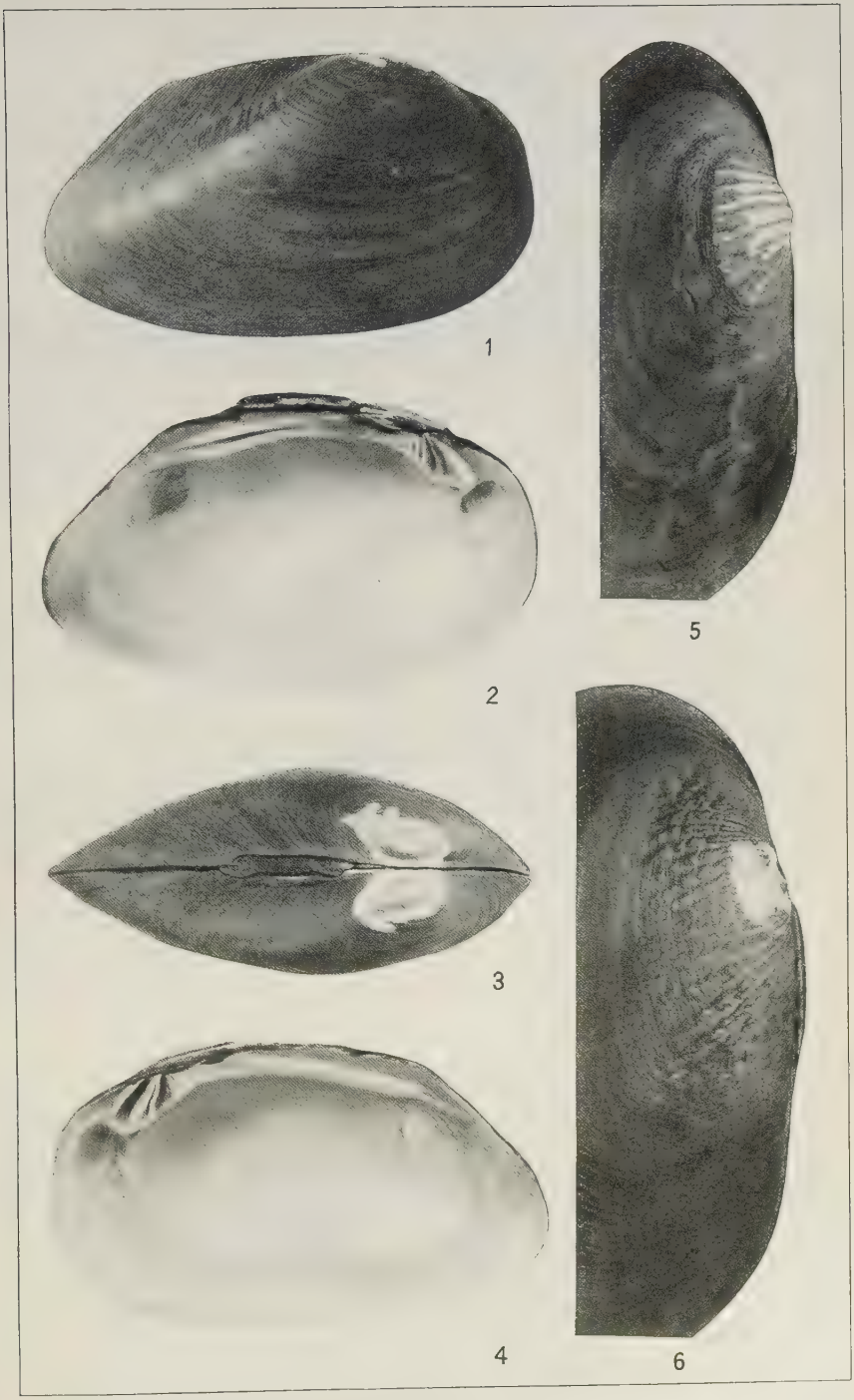
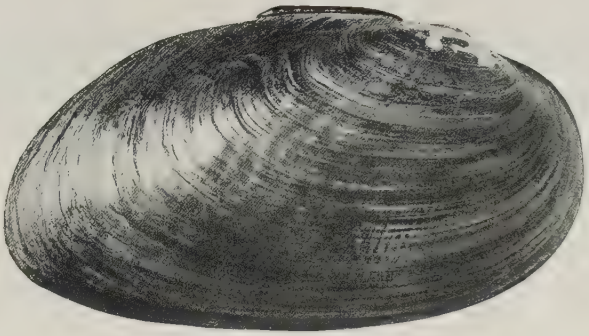
SOUTH AMERICAN DIPLODONS.

FOR EXPLANATION OF PLATE SEE PAGE 388.



SOUTH AMERICAN DIPLODONS.

FOR EXPLANATION OF PLATE SEE PAGE 388.



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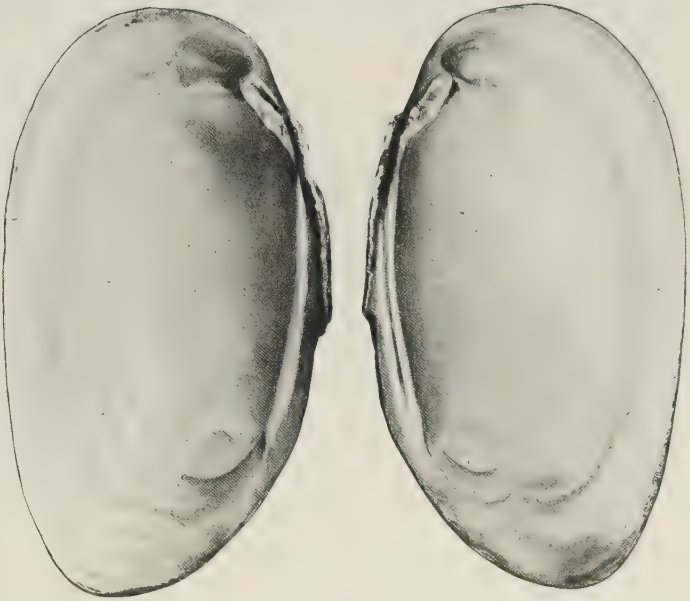

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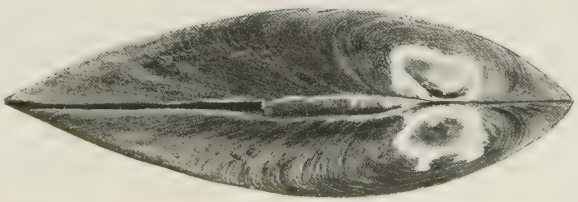

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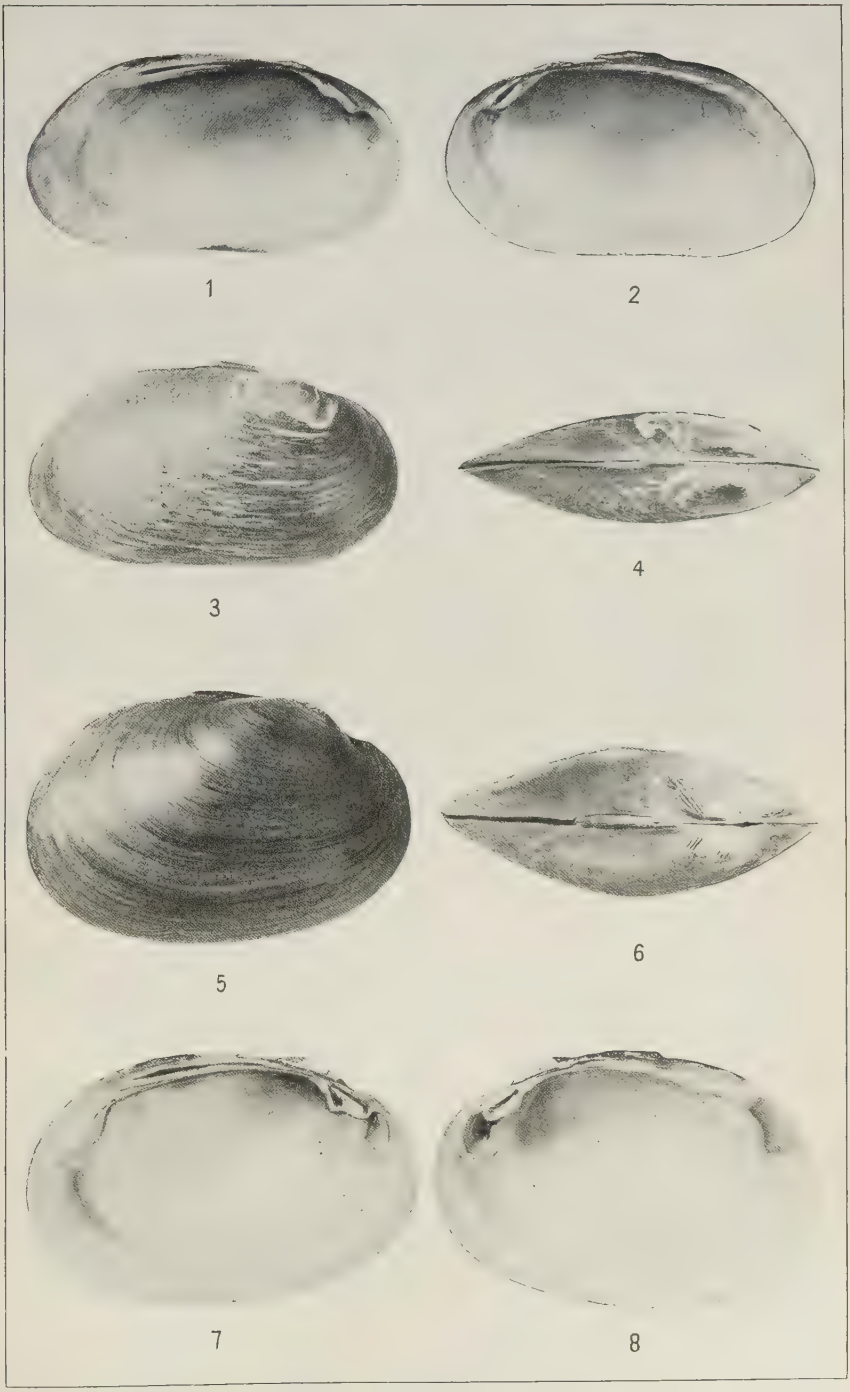
SOUTH AMERICAN DIPLODONS.

FOR EXPLANATION OF PLATE SEE PAGE 388.



SOUTH AMERICAN DIPLODONS.

FOR EXPLANATION OF PLATE SEE PAGE 388.

SOUTH AMERICAN DIPLODONS.

FOR EXPLANATION OF PLATE SEE PAGE 388.

SOME FOSSIL INSECTS FROM FLORISSANT, COLORADO.

By T. D. A. Cockerell,

Of the University of Colorado, Boulder.

The new species described below are in the collection of the United States National Museum. The three Hymenoptera are sawflies, bringing the total of Florissant fossil sawflies up to 42. The new *Plecia* brings the list of Florissant Bibionidæ to six, and the *Dioctria* is the thirteenth fossil Asilid from that locality. None of the genera are new to Florissant.

HYMENOPTERA.

TENTHREDELLA OBLITA, new species.

Length, about 12 mm.; width of head, 3 mm.; length of anterior wing, about 11 mm.; head, thorax, and antennæ, black; abdomen, dark, with the sutures pallid; wings, slightly dusky; nervures, fuscous. Venation normal for the genus; interradial vein strongly arched (much more so than in *T. saxorum*); second cubital cell long, receiving first recurrent vein near its middle; third cubital cell about twice as broad on apical side as on basal; lanceolate (anal) cell contracted, at the narrowest part a straight cross-nervure. In the hind wing the anal cell is broadly truncate, not at all petiolate, at the end.

The following measurements are in microns: First radial cell on third cubital, 832 (1136 in *T. saxorum*); second radial on third cubital, 336 (192 in *T. saxorum*); second cubital on first discoidal, 704 (560 in *T. saxorum*); second cubital on second (third, of authors,) discoidal, 736 (800 in *T. saxorum*); first discoidal on submedian, 336 (352 in *T. saxorum*); length of cross-vein of anal, about 160; width (depth) of anal at level of end of submedian cell, 480. The basal and first recurrent veins are parallel. Most nearly allied to *T. saxorum* Rohwer, but distinct by the quite different pattern of the abdomen and the details of the venation. Also allied to *T. avia* Brues, but the color-pattern is quite different, the veins are dark, and the anal cell is contracted at the cross-vein. *T. saxorum* has the apical part of the abdomen black, as in the living *Allantus unicinctus* Norton; while

the segments before the black are brown or ferruginous, each with a large black central spot, pointed posteriorly.

Miocene shales at Florissant (George Wilson.)

Holotype.—Cat. No. 63455, U.S.N.M.

PALEOTAXONUS VETUS, new species.

Length, 12 mm.; anterior wing, 9 mm.; width of abdomen, 3.25 mm.; head and thorax dark; legs apparently ferruginous; abdomen pallid, each segment with a median dusky patch and one at each side; wings perfectly clear, with ferruginous stigma and veins. Venation normal for the genus, with the characteristically formed first discoidal (which separates it at once from *Eriocampa*), the basal nervure meeting transversomedial, anal cell with oblique cross-vein, etc. The cubitellan cell is remarkably long.

The following measurements are in microns: Stigma beyond origin of interradial vein, 160; first radial cell on third cubital, 832; first radial on second cubital, 1200; second radial on third cubital, 352; second cubital on first discoidal, 240; second cubital on second discoidal, 1200; lower side of second discoidal, 1728. Hind wing: Upper side of cubitellan cell, 1680; cubitellan on discoidellan, 720; discoidellan on submediellan, 400; discoidellan on brachiellan, 800. I hesitated to separate this from *P. trivittatus* Rohwer, but it seems to be a distinct species, being larger, with the interradial vein placed as in *P. typicus* Brues. There is an intercostal vein. The very long cubitellan cell appears to be quite distinctive.

Miocene shales at Florissant (George Wilson). The specimen first studied lacked the ends of wings and abdomen, but these are present in the reverse, later noticed in the collection.

Holotype.—Cat. No. 63456, U.S.N.M.

ERIOCAMPOIDES MIMUS, new species.

Length, a little over 7 mm.; anterior wing, about 5.75 mm.; abdomen, 4.9 mm. long. Head black; thorax brown; the mesothorax pale; abdomen pallid, the apical 1.4 mm., dark fuscous; wings hyaline; stigma and nervures ferruginous; structure of wings nearly as in the living *E. aethiops*. Stigma truncate at end, hardly produced beyond origin of interradius, which is nearly vertical; interanal very oblique; anal cell contracted as usual. Measurements in microns: Third cubital cell on first radial, 448; first discoidal on median cell, 880; first discoidal on submedian, 368; first discoidal on first brachial, 592; lower side of first brachial, about 1280; submedian on second anal, 752; submediellan on brachiellan, 672. This looks like *E. micrarche* Cockerell, but the wing-measurements (*e. g.*, the long first brachial cell) are very different.

Miocene shales at Florissant (George Wilson).

Holotype.—Cat. No. 63457, U.S.N.M.

NEUROPTERA.

INOCELLIA TUMULATA Scudder.

A specimen collected at Florissant (Miocene shales) by Mr. George Wilson shows the ovipositor, which is about 6 mm. long. The anterior wings are 9.5 mm. long; the venation agrees in the main with Scudder's figure, but there are some differences, partly to be ascribed to variation and partly, I think, to error in Scudder's figure. The principal difference is that the cell in the first fork of the radial sector is relatively short, closed before the base of the cell in the fork of the upper branchlet.

HEMIPTERA.

METROBATES AETERNALIS Scudder.

A specimen from Florissant (George Wilson) shows the antennae, not described by Scudder. They are quite long and 175 μ thick near the base. The eyes are prominent.

DIPTERA.

PLECIA DECAPITATA, new species (Bibionidae).

Length about 10.5 mm.; thorax and legs dark; wings dusky but not very dark, the costal region not darker than the rest; abdomen 2.4 mm. wide, dark brown with narrow hyaline sutural bands, which are less than half as wide as the alternating dark ones. Separation of third vein from first about 3 mm. from base of wing and 5 from apex, the wings being 8 mm. long. The following measurements are in microns: Separation of third vein to anterior cross-vein about 1,600; depth of marginal cell at level of cross-vein, 480; origin of third vein to its fork (in a straight line), 2,560; end of first vein to end of second (upper branch of third), 720; end of first vein to end of lower branch of third, 2,240; depth of submarginal cell at level of end of second vein, 368.

Miocene shales of Florissant (George Wilson).

Holotype.—Cat. No. 63458, U.S.N.M.

This may be separated from the previously known species of *Plecia* from Florissant as follows:

Small, wing 6 mm. long ..... *melanderi* Cockerell.
Larger, wing 8 mm. or over ..... 1.
1. Wing long and narrow; marginal cell narrow, its greatest depth less than 400 μ ..... *explanata* Cockerell.
Wing, ordinary; marginal cell broader, its greatest depth over 450 μ ..... 2.
2. Abdomen with the light bands wider than the dark; submarginal cell broader ..... *axeliana* Cockerell.
Abdomen with the dark bands much wider than the light; submarginal cell narrower ..... *decapitata* Cockerell.

DIOCTRIA (?) PULVERIS, new species (Asilidae).

Length, 10.7 mm.; wings, 8 mm. long; hind femora, 2.5 mm., narrow basally, regularly enlarging to a stout apex; hind tibiae about 2.5 mm.; legs not bristly; head and thorax dark; abdomen long and slender, light reddish; thorax little elevated in profile; antennae poorly preserved, but third joint thick, much stouter than in modern *Dioctria;* wings, hyaline with light brown veins, no trace of a stigmatic spot. The venation is essentially as in *Dioctria*(?) *florissantina* Cockerell, and the insect appears to be certainly congeneric. The general appearance and the spineless legs suggest a Leptid, and the venation is close to that of the Leptid *Ptiolina*, though in other respects the insect is very different. Compared with *D. florissantina* the new species is larger, with a much broader (higher) second submarginal cell and paler veins, but the two are very similar. The base of the second posterior cell is not produced. The following wing measurments are in microns: End of first vein to end of second on margin, 1,280; end of first vein to vertical level of tip of wing, 2,048; depth of marginal cell at end of first vein, 320; depth of first submarginal cell at level of basal corner of second, 512; depth of second submarginal cell near end, 608; length of praefurca, 880; first submarginal on first basal, 832; first submarginal on first posterior, 2,400; second marginal on first posterior, about 2,080; first basal on discal, 736; first posterior on discal, 1,409; second posterior on discal, 176; third posterior on discal, about 336; second basal on discal, 336; second basal on fourth posterior, 176; second basal on fifth posterior, 384. The anal is closed not far from margin. Some of the corresponding measurements of *D. florissantina* are: First submarginal on first posterior, 1,632; first basal on discal, 672; first posterior on discal, 960.

Miocene shales of Florissant (George Wilson).

Holotype.—Cat. No. 63459, U.S.N.M.

THE SALAMANDERS OF THE GENERA DESMOGNATHUS AND LEUROGNATHUS.

By Emmett R. Dunn,
Of Haverford College, Haverford, Pennsylvania.

INTRODUCTION.

Although one of the species of *Desmognathus* is the commonest of the eastern salamanders, it was not observed by scientists until 1818, when Green described *Salamandra fusca*. This name was preoccupied by a name of Laurenti's. In the same paper Green described *Salamandra nigra*, which name has been used for a species of *Desmognathus* that Green probably never saw. In 1820 Rafinesque described *Triturus fuscus*, which is the earliest tenable name for a species of *Desmognathus*. This name of Rafinesque's remained unnoticed until 1849, the names *picta* (Harlan 1825), *nigra* (Green 1818), and *intermixta* (Green 1825), all being applied to the species now known as *fusca*. In 1838 Holbrook described *auriculata*, and in 1840 *quadramaculata*. He was the first to apply Green's *nigra* to the large black adult of *quadramaculata*. In 1849 Baird described the genus *Desmognathus* recognizing three species: *D. fusca* (Rafinesque), *D. auriculata* (Holbrook), and *D. nigra* (Green).[1] He placed *quadramaculata* in the synonomy of *fusca* where it stayed until Stejneger resurrected it in 1903.

Cope described *ochrophaea* in 1859. In 1866 he created a family, Desmognathidae, with only one genus. In 1868 he made *auriculata* a subspecies of *fusca*. In 1882 Boulenger added the genus *Thorius* Cope to the Desmognathinae. In 1892 Stejneger described *Typhlotriton* placing it in this family. So also in 1893 Cope in describing *Haptoglossa* included it in the Desmognathidae. Stejneger described *D. brimleyorum* in 1895. In 1899 Moore described *Leurognathus* as of the family Desmognathidae. In 1900 Moore showed clearly that this family had no standing if based on the opisthocoelous vertebrae.

In 1901 Allen claimed that *ochrophaea* should be a synonym of *fusca* and Fowler in 1906 supported his claim. In 1903 Stejneger

[1] The "only" specimen of *nigra* seen by Baird was No. 14001 in the Academy of Natural Sciences of Philadelphia. It was presented by Holbrook and the locality is given as "Penn."

redescribed *quadramaculata* as distinct from the form long known as *D. nigra* (Green). In 1908 Brown designated *D. fusca* (Rafinesque) as the type of *Desmognathus*. In preparing this revision I described *monticola* and *carolinensis*.

Passing from the systematic history of the group, one is struck by the number of papers on the anatomy and physiology of one form: *fusca*. This species, so easily obtainable throughout the East, has served as the basis for the researches of the Wilder's on the peculiarities of lungless salamanders. Mrs. Wilder has carefully worked out its life-history. Others have studied various phases of its morphology and embryology, so that this animal is by far the best known of the Plethodontidae.

MATERIAL.

Of *Leurognathus marmorata* I have seen six specimens. The type and one collected by S. N. Rhoads, in the Academy of Natural Sciences of Philadelphia; and two cotypes, an alcoholic and a skeleton, and an additional specimen in the University of Pennsylvania; and a larva in the American Museum of Natural History.

Of *Desmognathus* I have examined the following specimens: 1,093 in the United States National Museum; 1,105 in the Academy of Natural Sciences; 526 in the American Museum of Natural History; 56 in the Museum of Comparative Zoölogy; 52 in the Museum of the University of Pennsylvania; 144 in the Museum of Cornell University; and 194 in my private collection, making a total of 3,170.

The United States National Museum contains all the existing types of species of Desmognathus, i. e., of *D. brimleyorum* Stejneger, *D. monticola* Dunn and *D. ochrophaea carolinensis* Dunn.

ACKNOWLEDGMENTS.

I desire to express my gratitude to Mr. Leonhard Stejneger, who suggested this research to me, for his kind advice and assistance, and for permission to study the collection of the United States National Museum; to Mr. R. G. Paine and Mr. H. A. O'Dwyer, of the Division of Reptiles, for help in studying the collection; to Dr. H. W. Fowler, who allowed me to study the collection of the Academy of Natural Sciences in Philadelphia, for his interest and suggestions; to Miss Mary C. Dickerson, who gave me the opportunity to study the North Carolina fauna in life, and who lent me the collection of the American Museum of Natural History, in New York City; to Dr. Thomas Barbour, who lent me specimens from the Museum of Comparative Zoölogy, in Cambridge, Massachusetts; to Dr. Percy Moore, who gave me the opportunity to study his specimens of *Leurognathus* and *Desmognathus* in the University of Pennsylvania Museum, and who permitted me to use his drawings of *Leurognathus;* to Dr. A. H. Wright, of Cornell University, for the loan of specimens; to Dr. and

Mrs. Wilder, of Smith College, Northampton, Massachusetts, for advice and specimens; and finally to Dr. H. S. Pratt, of Haverford College, under whom I studied, who has shown great interest in this work, and allowed me to use the resources of the college laboratory with the greatest freedom, especially in the matter of procuring specimen s

RELATIONSHIPS OF THE GENERA.

Cope established a family Desmognathidae on the strength of the opisthocoelous vertebrae of *Desmognathus*. *Thorius*, *Haptoglossa*, *Typhlotriton*, and *Leurognathus*, were added at various times to the family chiefly on this character. Moore (1900) showed that opisthocoelous vertebrae are in many salamanders concomitant with age, and that old specimens of various species of *Spelerpes*, *Gyrinophilus*, and *Autodax* have vertebrae quite as opistocoelous as has *Desmognathus*. Consequently the family can not stand.

Thorius Cope, with a boletoid tongue and prefrontal bones, tends to *Spelerpes*.

Typhlotriton according to Cope (1893*a*) has the same peculiar structure of the atlas found in *Desmognathus* and *Leurognathus*. However, it has prefrontal bones and a premaxillary fontanelle. The tongue is attached in front, although according to Hilton (1909*b*), it is in the larval state more like the tongue of *Spelerpes* than that of *Desmognathus*.

Its position, then, would be between these two genera.

Leurognathus Moore seems closely related to *Desmognathus* in structure of tongue and skull. The prefrontal bones are lacking in both. The peculiar structure of the atlas is alike in both. *Leurognathus* so far as known never has vomerine teeth. In this it is unique save that the males of some species of *Desmognathus* lose the vomerine teeth on arriving at sexual maturity.

The cranial structure of *Haptoglossa* Cope is unknown. .

Batrachoseps Bonaparte has no prefrontal bones, but this has been shown by Cope to be an independent loss and the genus tends to *Plethodon*. *Stereochilus* Cope is not well known. Cope says that in the only skull he examined the prefrontal bone was present on one side and absent on the other. Besides *Leurognathus*, *Stereochilus* is, according to Cope, the only other genus of Plethodontidae without premaxillary fontanelle. This may or may not indicate relationship.

Therefore *Desmognathus* and *Leurognathus* form a closely related group, which is apparently isolated from other genera of Plethodontidae.

However, the cranial structure of *Haptoglossa* and *Stereochilus* should be examined for possible relationships.

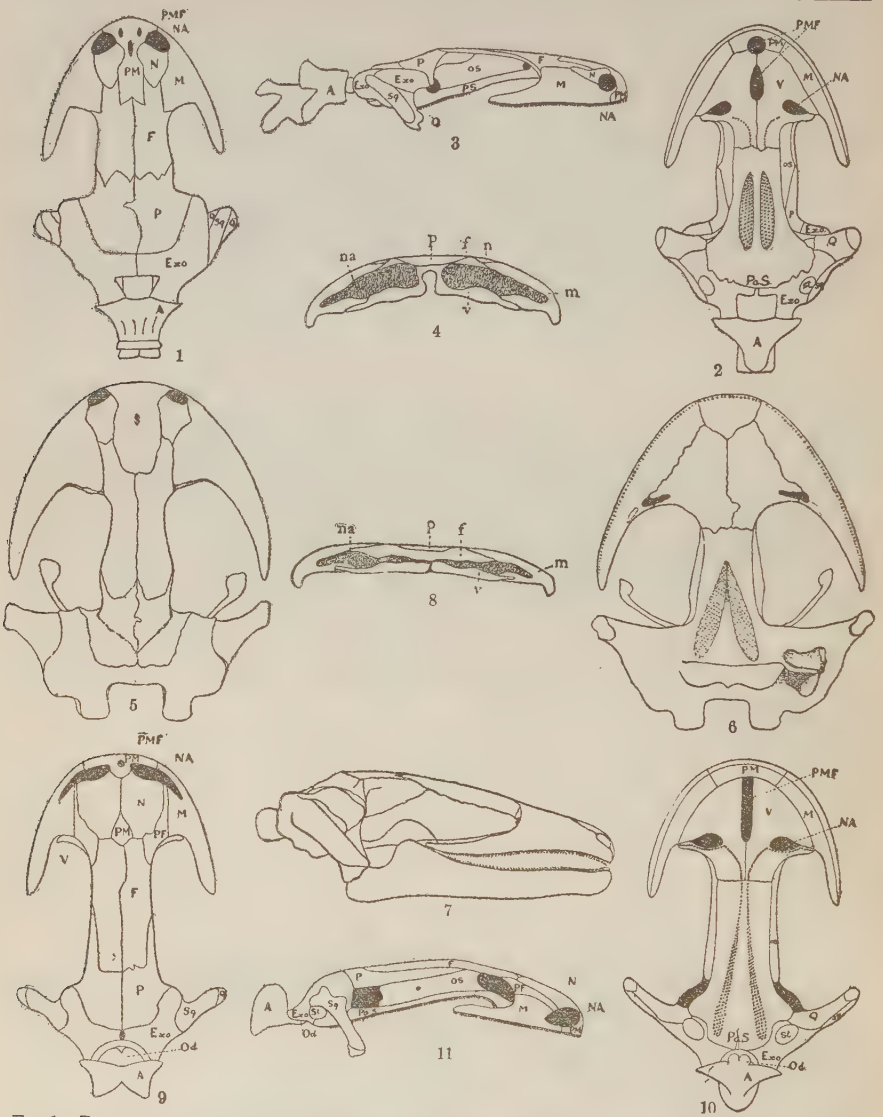


FIG. 1.—DORSAL VIEW OF SKULL OF DESMOGNATHUS FUSCA, 3 × NAT. SIZE. *A*, ATLAS; *ExO*, EXOCCIPITAL BONE (THE OCCIPITO-PETROSAL OF WIEDERSHEIM); *F*, FRONTAL BONE; *M*, MAXILLARY BONE: *NA*, NARES: *N*, NASAL BONE; *P*, PARIETAL BONE; *PM*, PREMAXILLARY BONE; *PMF*, PREMAXILLARY FONTANELLE; *Q*, QUADRATE BONE; *Sq*, SQUAMOSAL BONE.

FIG. 2.—VENTRAL VIEW OF SAME, 3 × NAT. SIZE (TEETH SOMEWHAT DIAGRAMMATIC): *Os*, ORBITOSPHENOID BONE; *PaS*, PARASPHENOID BONE; *St*, STAPES; *V*, VOMER; OTHER LETTERS AS BEFORE.

FIG. 3.—LATERAL VIEW OF SAME, 3 × NAT. SIZE: LETTERS AS BEFORE.

FIG. 4.—A SECTION OF THE SKULL OF DESMOGNATHUS QUADRAMACULATA TAKEN JUST ANTERIOR TO THE INTERNAL NARES, 3.5 × NAT. SIZE. *f*, FRONTAL; *m*, MAXILLARY; *n*, NASAL; *na*, NASALPASSAGE, WHICH IS INDICATED BY SHADING; *p*, PREMAXILLARY; *v*, VOMERO-PALATINE.

FIG. 5.—DORSAL VIEW OF A FEMALE LEUROGNATHUS MARMORATA, 3.2 × NAT. SIZE.

FIG. 6.—VENTRAL VIEW OF SAME, 3.2 × NAT. SIZE. THE INTERNAL NARES ARE BLACKENED, AND THE POSITION OF THE ACTUAL CHOANAE IN THE ENTIRE HEAD IS INDICATED BY A RING OF DOTS.

FIG. 7.—LATERAL VIEW OF SAME, 3.2 × NAT. SIZE.

FIG. 8.—A SECTION OF THE SKULL OF THE SAME TAKEN JUST ANTERIOR TO THE INTERNAL NARES, 3.5 × NAT. SIZE. LETTERS AS IN FIG. 4.

FIG 9.—DORSAL VIEW OF SKULL OF SPELERPES RUBER, 3 × NAT. SIZE. *Od*, ODONTOID PROCESS OF ATLAS; *PF*, PREFRONTAL BONE; OTHER LETTERS AS BEFORE.

FIG. 10.—VENTRAL VIEW OF SAME, 3 × NAT. SIZE. LETTERS AS BEFORE. (TEETH SOMEWHAT DIAGRAMMATIC.)

FIG. 11.—LATERAL VIEW OF SAME, 3 × NAT. SIZE. LETTERS AS BEFORE.

[Figs. 1–3 and 9–11 by the author; figs. 4–8 are here reproduced by the kind permission of Dr. Moore.]

VARIATION OF THE CHARACTERS.

Dentition.—This has been studied chiefly by taking impressions of teeth on thin shavings of a preparation of beeswax and lampblack.

The shape and presence of the vomerine teeth are quite constant in the various forms. The females always have them, but the males of all species save *quadramaculata* and *monticola* lose them at sexual maturity. Some, but not all, old male *monticola* lack the vomerines.

In some specimens of *fusca* and in most of *ochrophaea* and *carolinensis* the vomerine teeth are on a bony ridge which often persists after the teeth themselves are lost.

The parasphenoid patches change somewhat in shape with age and are slightly different in male and female. Aside from this they are variable and must be used only in connection with other characters.

The mandibular dentition of male *ochrophaea* is merely an exaggeration of that seen in male *fusca*, but it is marked and constant. The shape of the tongue is subject to so much variation, which is probably due to differences of preparation, that I have been unable to use it as a diagnostic character.

Tail and limbs.—The shape of the tail is constant and not subject to sexual or seasonal changes. I have found no seasonal changes in these salamanders, save that "in the breeding season the lips of the cloaca are somewhat everted" (Mrs. Wilder). The absence of the dorsal fold is characteristic of the *ochrophaea* group.

The relative length of the tail is also fairly constant. The tails are frequently broken and regenerated, so that it is impossible to tell the normal. Results of maximum tail-lengths range the species in the same order as average tail-lengths so that any error resulting from mutilation is of no consequence.

The size of the legs is quite constant in specimens of the same age. The distance between the appressed toes is less in youth than in age. But the change is not the same for all forms. Thus young *monticola* have two intercostal spaces between the appressed limbs and old *monticola* three; while young *fusca* have three and a half and old ones four. The larvae, young, and adult of *quadramaculata* have two and a half to three quite constantly.

Head.—The skin of the head is sometimes very rugose. This is very noticeable in specimens of *quadramaculata* and *monticola*. While the majority of specimens possess it, I have been able to find no other character accompanying it and am inclined to set its absence down to an artifact of preservation or an individual or local variation. It is not usually found, however, in old and black specimens of *quadramaculata*.

The size of the head is a constant but hard to use, as it has to be relative and the limits of variation are small.

Size.—Adult size is subject to some local variation, but is otherwise constant. In the *fusca* and *ochrophaea* groups males are larger than females.

The disparity in size is greater than the total length measurement would show, as the tails of females are larger than the tails of males. Similarly the much greater size of *quadramaculata* is better shown when measurements of head and body are compared as the shortness of the tail in this form obscures the difference when total lengths are compared.

Costal grooves.—The costal grooves are not of much use in separating forms of this genus. They vary from a minimum of 12 in *quadramaculata* to a maximum of a possible 15 in *brimleyorum*. Fourteen is normal, counting the axillary and inguinal. The inguinal in specimens with 14 may be either a distinct groove or a fork of the thirteenth. Where there are only 12 this fork is lacking and No. 1 does not quite reach into the axilla. To quote from Cope (1889) speaking of *ochrophaea:* "The costal folds are 13, but 14 if that which is immediately above the groin be counted. The first falls immediately into the axilla. This is the characteristic arrangement in *D. fusca* also, while in *D. nigra* the fold above the groin usually extends to it and is the twelfth, while that which corresponds to the first of the species last named falls just in advance of the axilla. Though this is typical of *D. nigra*, occasionally another plica appears above the groin and the twelfth is slightly in front of it."

It will be seen from this that the number of costal grooves in this genus can not be used as a character of any great value.

The tubercle canthus oculi is present in all forms save typical *ochrophaea*. I have been unable to use the lateral pores as diagnostic characters. This is largely because the distinctness of these pores is so dependent on the preservation. In some specimens they are quite evident. In others of the same species they are scarcely to be observed at all.

Color.—The shades are extremely variable, but I have found the general markings to be quite constant. In all of the forms there is a marked tendency for the dorsal surface to become black with age.

In *quadramaculata* the ventral surface also becomes dark with age, and *carolinensis* and *monticola* show a tendency in this direction. In the other species the belly assumes its permanent coloration shortly after transformation.

Measurements.—In measurements the head length is taken from the tip of the snout to the middle of the gular fold. The head width is taken at the angle of the jaws. The tail is taken as beginning at the posterior angle of the vent.

Subfamily DISMOGNATHINAE.

Key to the genera.

a^1 Internal nares conspicuous, about as far apart as nostrils.....*Desmognathus.*
a^2 Internal nares very inconspicuous, twice as far apart as nostrils.*Leurognathus.*

Genus DESMOGNATHUS Baird.

1849. *Desmognathus* BAIRD, Journ. Acad. Nat. Sci. Philadelphia (n. s.), vol. 1, p. 82.
1854. *Cylindrosoma* (part) DUMÉRIL and BIBRON, Erpétologie Générale, vol. 9, p. 81.
1854. *Plethodon* (part) DUMÉRIL and BIBRON, Erpétologie Générale, vol. 9, p. 85.
1854. *Ambystoma* (part) DUMÉRIL and BIBRON, Erpétologie Générale, vol. 9, p. 105.
1856. *Plethodon* (part) HALLOWELL, Proc. Acad. Nat. Sci. Philadelphia, pp. 6–11.

Type-species.—*Triturus fuscus* Rafinesque.

Diagnosis.—General characters of the Plethodontidae. Tongue attached, except by its lateral margins. Prefrontal bone wanting. Premaxillaries united, embracing a fontanelle. Structure of internal nares as in *Spelerpes;* that is, a notch in the vomer.

Vertebrae opisthocoelous in the adult. Atlas without odontoid process and with a transverse dorsal ridge on which the temporal muscles originate.

Occipital condyles on cylindric pedestals. Vomerine teeth usually present, but wanting in adult males of some species. A light line from the eye to the angle of the jaw.

There seems to be three groups of nearly equal value. These are: 1. *quadramaculata;* 2. *monticola, fusca, auriculata,* and *brimleyorum;* 3. *carolinensis* and *ochrophaea.*

Distribution.—The forms of *Desmognathus* occur all over the eastern United States. Two specimens show that the genus is represented in New Brunswick. There is also a record for the Gaspe peninsula, but as this refers to larvae it is extremely doubtful. Nash's records for *D. fusca* and *D. nigra* in southwest Ontario are also doubtful. It can be affirmed with considerable positiveness that *quadramaculata* does not occur in Canada, and from the known distribution of *fusca* it seems scarcely probable that it either is found in Ontario.

Specimens and records are lacking from northwestern Ohio, northern Indiana, northern Illinois, western Kentucky, western Tennessee, and northern Mississippi. In Arkansas, *brimleyorum* from two neighboring localities is the only representative. Beyer (1900) records *fusca* as common all over Louisiana. I have seen specimens from only the southeastern corner and these were *auriculata.* It is very doubtful whether typical *fusca* occurs in Louisiana.

In mapping the ranges of the various forms one is struck by the agreements with the maps in Transeau's paper on the Forest Centers

of Eastern North America. Thus the distribution of *fusca* is roughly the eastern deciduous forest; *ochrophaea* the northern coniferous forest; *carolinensis* the southern extension of the same; and *auriculata* the southern coniferous forest.

LIST OF SPECIES AND SUBSPECIES WITH TYPE-LOCALITIES.

Desmognathus quadramaculata (Holbrook), Carolina.
Desmognathus monticola Dunn, Brevard, North Carolina.
Desmognathus fusca fusca (Rafinesque), northern New York.
Desmognathus fusca auriculata (Holbrook), Riceboro, Georgia.
Desmognathus brimleyorum Stejneger, Hot Springs, Arkansas.
Desmognathus ochrophaea ochrophaea Cope, Susquehanna County, Pennsylvania.
Desmognathus ochrophaea carolinensis Dunn, Mount Mitchell North Carolina.

Key to adults of Desmognathus.

a^1. Tail not keeled, cylindrical. Small species.
  b^1. No tubercle in the anterior angle of the eye; belly light..... *D. ochrophaea ochrophaea.*
  b^2. A tubercle in the anterior angle of the eye; belly dark..... *D. ochrophaea carolinensis.*
a^2. Tail keeled above. Large and medium species.
  b^1. Belly uniformly colored.
    c^1. Belly black; large and stout; tail short..... *D. quadramaculata.*
    c^2. Belly light; tail long; no light spots on sides..... *D. monticola.*
  b^1. Belly mottled.
    c^1. No light spots on sides ..... *D. fusca fusca.*
    c^2 A row of light spots on sides.
      d^1. Belly dark..... *D. fusca auriculata.*
      d^2. Arkansas. Belly light ..... *D. brimleyorum.*

IDENTIFICATION OF LARVAE.

From the larvae of other genera of Plethodontidae (except only *Leurognathus marmorata*, q. v.) larvae of *Desmognathus* may be told by their glistening white gills, which are never so long or so large as the gills of *Spelerpes*, etc., larvae. The legs are stout, especially the hind pair. The whole outline of the body and the markings are very like those of the adult. I have seen larva of *quadramaculata* and *fusca*. These may be distinguished by the larger size and uniform pigmentation of *quadramaculata*. Larvae of *fusca*, *monticola*, or *carolinensis* are not found during July and August, but larvae of *quadramaculata* are found throughout the summer.

Larvae of *fusca* are found among leaves and débris in very shallow water near the surface. Larvae of *quadramaculata* are found under rocks in the mountain brooks where the adult is also found.

Spelerpes larvae, on the other hand, are usually found on the bottom of springs and small streams.

DESMOGNATHUS QUADRAMACULATA Holbrook.

1840. *Salamandra quadramaculata* HOLBROOK, N. Amer. Herpetology, ed. 1, vol. 4, pl. 27.

1840. *Salamandra maculo-quadrata* HOLBROOK, N. Amer. Herpetology, vol. 4, p. 121.

1842. *Salamandra quadrimaculata* HOLBROOK, N. Amer. Herpetology, ed. 2, vol. 5, p. 49, pl. 13.

1842. *Triton niger* (part) HOLBROOK, N. Amer. Herpetology, ed. 2, vol. 5, p. 81 (not of Green).

1849. *Desmognathus niger* BAIRD, Journ. Acad. Nat. Sci. Philadelphia, (n. s.) vol. 1, p. 285.

1854. *Ambystoma nigrum* DUMÉRIL and BIBRON, Erpétologie Générale, vol. 9, p. 125.

1903. *Desmognathus quadrimaculata* STEJNEGER, Proc. U. S. Nat. Mus., vol. 26, p. 557.

Type.—So far as known there is none.

Type-locality.—Holbrook (1840) says "I first found it in the Carolinas."

Distribution.—From Wytheville and Giles County, Virginia, southward in the Alleghenies into Georgia and South Carolina. Zonal range Transition and Canadian. Vertical range, 2,000–6,000 (Roan Mountain).

Diagnosis.—Vomerine teeth always present. Parasphenoid series confluent anteriorly. Legs stout. Two and a half to three costal interspaces between appressed toes. Tail flattened, keeled, and finned above. Head very large. Size large. No distinct color pattern. Belly black. Larvae: Total length to 79 mm. Transformed specimens: Total length 49–164 mm. Head and body 27–100 mm.

Description.—The vomerine teeth are always present and form two arched series which extend nearly to the nares and approach each other posteriorly within one-fourth of their own length. When complete there are are 8–9 teeth in each series. The parasphenoid series are very long narrow patches, confluent anteriorly, which approach the vomeries from one-third to two-thirds the length of the vomerine series.

The tongue seems usually small and round, but it is variable.

The tail is always shorter than the head and body, and is usually flattened and finned.

The legs are very large and stout. The number of costal spaces between the appressed toes is two and a half to three.

The head length is from three and two-thirds to four and a half in the length of head and body. The head width is about five in the length of head and body.

This is the largest species in the genus, with a long head, long body, short tail, and long legs.

The skin of the head is often rugose, resembling, as Stejneger says, "grain leather." This character is present in *monticola* and to some degree in *carolinensis*. Old and black specimens of *quadramaculata* do not, as a rule, have it. In nine specimens from Giles County, Virginia, five had the head perfectly smooth, in two it was very rough, and two were intermediate. The tubercle canthus occuli is always present.

The X-shaped groove on top of the head, between and in front of the eyes, is lacking in this species. It is present in all the other

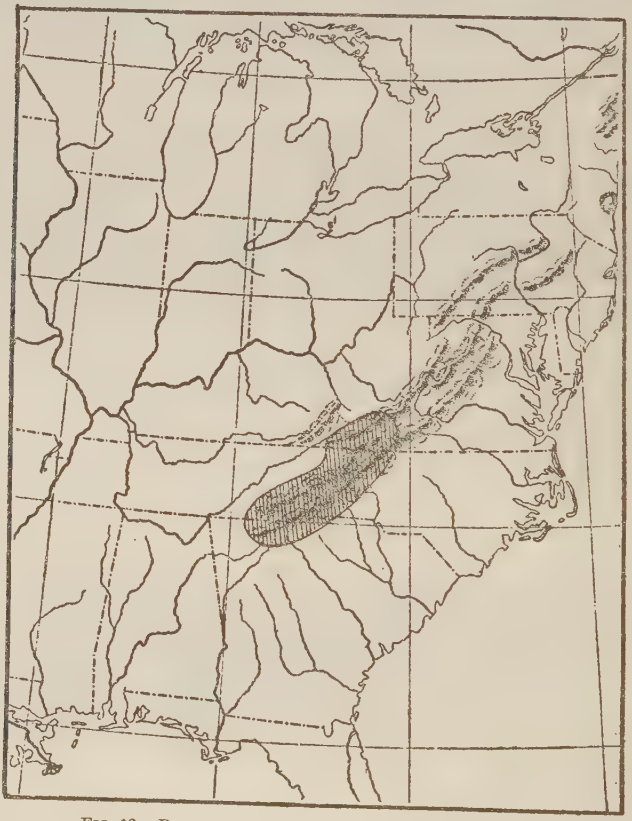


FIG. 12.—RANGE OF DESMOGNATHUS QUADRAMACULATA.

forms of the genus. This is useful in separating this form from dark *monticola*.

In this form the costal grooves are at a minimum. Some specimens have only 12; others have 13 and 14.

The color of this form is very characteristic. The dorsal surface shows a lack of pattern not found in any other species. The larva is almost uniform brownish above and uncolored below. The young are at first like the larvae, but the dorsal color becomes gradually darker until it is black in old specimens. The color of the head is, in most specimens, much lighter than that of the body. The belly,

white in the young, soon begins to blacken in an area laterally very definitely defined by a line between the ventral insertion of the legs. Medium-sized specimens have the back dark, the sides light, and the belly dark. The dorsal surface is never lighter than the sides as it is in all the other forms of the genus. Old specimens become uniformly black save for the head and feet which remain brownish and whitish.

In view of the lack of definite color pattern, question may arise as to the applicability of Holbrook's name to this species. The proportions and ventral coloration of Holbrook's plate are those of this form. The dorsal spots are more distinct in Holbrook's figure than in any specimen I have seen. But, as Stejneger says, some specimens approach it and the other characters agree exactly with this form and with no other.

I can find no sexual differences in this form. The testes are not pigmented, as are those of *fusca* and *ochrophaea*.

Habits.—According to my own experience, this is by far the most aquatic species of the genus. I have found them swimming about in streams as large as the Linville River. They are extremely active and hard to catch or hold. It is a surprising sight to see one of these big black salamanders run down a sloping bank into the water for all the world like a water snake.

On several occasions captured specimens attempted biting.

Around Brevard, North Carolina, they came down to 2,100 feet in large streams, to which they seemed practically confined. At Linville, North Carolina, where the valley was 3,800 feet, they inhabited large and small streams, irrespectively.

The explanation seems to be that *D. monticola* inhabits small streams which rise at or below 4,000 feet, while *D. quadramaculata* follows down streams which rise above that line. This is not an absolute rule, but it holds in most cases, and a stream in which *quadramaculata* is common usually contains few *monticola*, and the opposite.

The food seems not definitely known.

Nothing has been published on the breeding habits. The condition of the ovaries in females would indicate September as the beginning of the egg-laying period. Specimens have been seen which were taken in May, July, and September. In May the eggs were not developed. In July the eggs were in all cases well developed. In September the eggs were developed in some cases and not in others. This would show that some of the September females had spawned and others had not.

The larvae reach a much larger size than in any of the other species. The smallest transformed example seen was 52 mm. long, and the largest larva was 79 mm. long. Females appear to be

sexually mature at a total length of 107 mm. with head and body 57 mm.

Remarks.—This seems the most primitive form in the genus Its larvae are the largest. The male never loses its vomerine teeth. There is no difference between male and female in size or hooking of the jaws.

In these characters it leans away from the other species of *Desmognathus* and toward the majority of salamanders. Two other points of interest are that its size is the largest of the genus and that it is strikingly similar externally to *Leurognathus marmorata*, the only species of the only closely allied genus.

There are several specimens of this form with doubtful locality records. These are: No. 183 Mus. Comp. Zoöl., presented by Doctor Holbrook, locality Charleston, South Carolina; No. 14001 Acad. Nat. Sci., presented by Doctor Holbrook, locality Pennsylvania; No. 3883 U.S.N.M. Meadville, Pennsylvania; No. 3823 U.S.N.M. Cook County, Illinois; No. 8802 U.S.N.M. Augusta, Georgia. Aside from these the specimens are all within the distribution given. No modern specimens of this unmistakable form are known from outside this range.

Green's *Salamandra nigra* (1818) is not this form. Holbrook's two specimens are the oldest ones known and hence it is doubtful if Green ever saw a specimen of what has been called *Desmognathus nigra* (Green).

Specimens examined: 213, from the following localities:

Illinois.—Cook County (?) 1.

Pennsylvania.—1 (?); Meadville (?), 1.

Virginia.—Wytheville, 1; Giles County, 9.

North Carolina.—Cherokee, 1; Bald and Sampson Mountains, 1; Haywood County, 3; Pink Beds, 3; Brevard, 61; Blantyre, 5; Mount Mitchell, 3; Spruce Pine-Micaville, 1; Henderson County, 3; Pineola-Mortimer, 7; Linville, 43; Blowing Rock, 49; Grandfather Mountain, 3; Roan Mountain, 4.

Tennessee.—1; Roan Mountain, 1.

South Carolina.—Abbeville, 2; Charleston (?), 1.

Georgia.—1; Augusta (?), 1.

No locality.—Three.

DESMOGNATHUS MONTICOLA Dunn.

1916. *Desmognathus monticola* DUNN, Proc. Biol. Soc. Washington, vol. 29, p. 73.

Type.—No. 38313 U.S.N.M., adult male.

Type-locality.—Elk Lodge Lake, near Brevard, North Carolina; altitude about 2,500 feet. Type collected by Ronald and Emeline Tipping, July 13, 1908.

Distribution.—From Clarke County, Virginia, and Greenbrier County, West Virginia, south in the mountains to Toccoa, Georgia.

Zonal range transition. Vertical range: 500 feet (Clarke County, Virginia), 4,500 feet (Tatula Mountain, North Carolina).

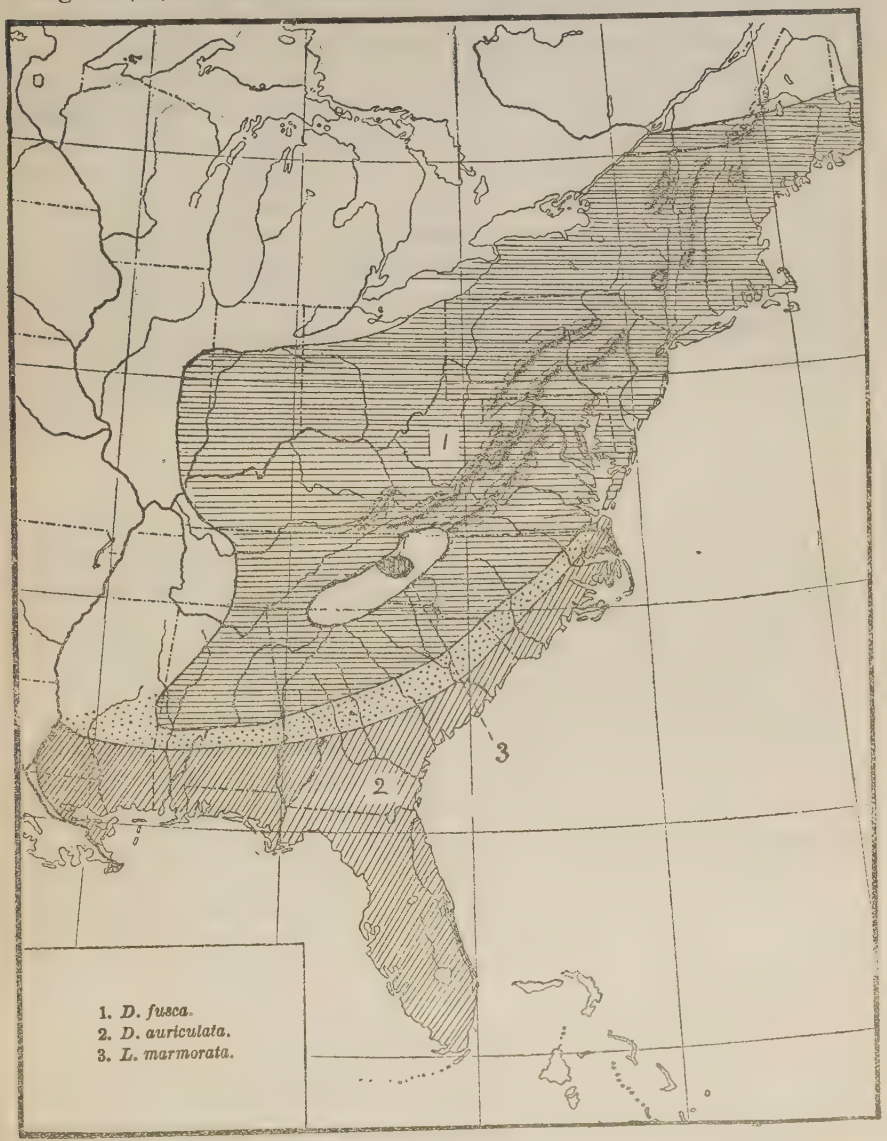


FIG. 13.—RANGES OF 1, DESMOGNATHUS FUSCA FUSCA; 2, D. FUSCA AURICULATA; 3, LEUROGNATHUS MARMORATA. (DOTTED AREA SHOWS INTERGRADATION.)

Diagnosis.—Vomerine teeth not lost by males on reaching sexual maturity. (The largest and probably the oldest males lack these teeth. Others, however, many as large as the largest *fusca* and undoubtedly sexually mature, have these teeth. When lost it is a senile change.) Parasphenoids confluent anteriorly. Legs stout.

Three costal interspaces between appressed toes of adult. Tail keeled above. A distinct color pattern. Belly uniform, pale. Transformed specimens: Total length 30–135 mm.; head and body 17–64 mm.

Description.—The vomerines form two short slightly arched series which approximate each other in the median line. The parasphenoids are usually confluent anteriorly. They are long narrow series and are well separated from each other save in front. Their distance from the vomerines is about equal to the length of one of the vomerine series. The shape of the tail is about as in *fusca*. The relative length is greater. It is not as flattened as in *quadramaculata*.

The legs are stout. In young specimens the appressed toes are separated by two costal interspaces, in adults by three.

The length of the head is from four to four and a half in the length of head and body. The head is from five to six in the length of head and body.

This is the second largest form in the genus with medium head and body, long tail, and medium legs.

The skin of the head is often rugose as in *quadramaculata*. The costal grooves are 13 or 14 in number. There is always a tubercle in the anterior angle of the eye.

The color of this form is much like that of *fusca*, but shows certain differences. The light dorsal spots are smaller and more heavily outlined with dark. They do not break up until the animal is practically mature; whereas in *fusca* it is seldom, even in the smallest transformed specimens, that they have not coalesced into a light dorsal band. When these spots do coalesce in *monticola* portions of the dark outline are left as conspicuous dark spots on the generally pale dorsal band. The ventral coloration is practically uniform and lacks all trace of the mottling so conspicuous in *fusca*. The sides are not mottled as in *fusca*, but the dark lateral band merges gradually into pale ventral surface. In the young the belly is white. A uniform pigmentation gradually encroaches on the belly from the sides inward and from behind forward, so that the last unpigmented part of the ventral surface is between the fore legs. Eventually the whole belly is uniformly and lightly pigmented. In a few specimens this pigmentation is fairly dark, never, however, becoming as dark as in *quadramaculata*. In comparing *monticola* with the latter, it should be remarked that *monticola* usually retains traces of the dorsal pattern and never has the light lateral band so characteristic of young and medium *quadramaculata*.

The only sexual difference discernible is the very slightly more flexuous outline of the male jaw. The testes are unpigmented as in *quadramaculata*.

Habits.—This species resembles *fusca* very closely in its habitat relations. It is not nearly so aquatic as *quadramaculata*, and is found only in small streams. The rocky edges of the mountain

brooks and the springs along the sides of the roads simply teem with this species. It wanders more openly than do the other species of the genus. I once sat on the side of a road under a tree during a rain and four or five large examples crossed the road in half an hour. While we were climbing Grandmother Mountain early one morning, one ran across our path with a partially swallowed earthworm in its mouth. In this roaming tendency it resembles *quadramaculata*, which is also frequently seen in action, but which is confined to streams.

The vertical range of those observed by me was from 2,200 to 4,000 feet. This applies only to the North Carolina mountains. In Virginia it comes down to 500 feet.

No larvae have been seen. The breeding habits are not known, but they are probably similar to those of *fusca*. Transformed specimens have been seen as small as 30 mm. Females seem to be sexually mature at a total length of 105 mm.; head and body, 51 mm.

Remarks.—This animal is intermediate between *fusca* and *quadramaculata*, with which two species it was confused. It is the only species of the genus besides *quadramaculata* in which the male retains the vomerine teeth past sexual maturity.

It is apparently distinct from both of the others, as no specimens of an intermediate nature have been seen, and as it occurs with *quadramaculata* in North Carolina, and with *fusca* in Virginia.

Specimens examined, 173, from localities as follows:

Virginia.—Delaplane, 2; Clarke County, 1; Berry's Ferry, Clarke County, 1; Hanging Rock, Clarke County, 8; Stony Man, 1; Augusta County, 2.

West Virginia.—Greenbrier County, 2; Baileysville, 2; Star Creek, 2; Horsepen Creek, 1; Big Stony Creek, near Barger's Spring, 1.

North Carolina.—Brevard (type-locality), 90; Pink Beds, 9; Blantyre, 4; Sunburst, 3; Joanna Bald, near Andrews, 1; Burnsville, 1; Cane River, 3; Spruce Pine-Micaville, 1; Linville, 18; Blowing Rock, 2; Pineola-Mortimer, 1; Tatula Mountain, near Highlands, 1.

Georgia.—Clayton, 1; Tallulah Falls, 4; Toccoa, 1.

DESMOGNATHUS FUSCA FUSCA (Rafinesque).

1818. *Salamandra fusca* GREEN, Journ. Acad. Philadelphia, vol. 1, pp. 348–359 (not of Laurenti, 1768).

1820. *Triturus fuscus* RAFINESQUE, Annals of Nature, vol. 1, p. 4.

1825. *Salamandra intermixta* GREEN, Hall's Portfolio, vol. 20, p. 159.

1842. *Triton niger* (part) HOLBROOK, N. Amer. Herp., ed. 2, vol. 5.

1849. *Desmognathus fuscus* BAIRD, Journ. Acad. Philadelphia (n. s.). vol. 1, p. 285.

1854. *Plethodon fuscum* DUMÉRIL and BIBRON, Erpétologie Générale, vol. 9, p. 85.

1856. *Plethodon niger* HALLOWELL, Proc. Acad. Nat. Sci. Philadelphia, pp. 6–11.

Type.—Not known to exist.

Type-locality.—Northern New York.

Distribution.—From St. John's River, New Brunswick, and Rangeley, Maine, to Raleigh, North Carolina: Dayton, Alabama; David-

son County, Tennessee; Edmondson County, Kentucky; and Normal, Illinois.

It occurs as far up the French Broad River as Asheville, but is not otherwise known from the mountains of North Carolina.

Diagnosis.—Vomerine teeth lost in male on attainment of sexual maturity. Parasphenoids never confluent. Appressed toes separated by four intercostal spaces. Tail keeled above. A distinct color pattern. Belly mottled, light. No row of light spots on sides. Larvae: total length to 44 mm. Transformed specimens: Total length 29–100 mm., females, 128 mm., males; head and body 20–67 mm., males, 52 mm., females.[1]

Description.—Vomerine teeth always present in females; lost in males at sexual maturity. They form two arched series, which, when complete, are composed of five to six teeth. The series is separated by one and a half its length from the parasphenoids. They do not extend beyond the nares, but approach each other within one-fourth their own length.

The parasphenoid teeth form two rather short, thick, completely separated series.

The tail in the adult is trigonal in cross-section near the base, the distal half has a dorsal keel which is a simple fold of skin. This sometimes extends to the anus but usually only in young specimens.

The tail is larger in females than in males. In a series of 23 females from Haverford, Pennsylvania, 5 had the tail longer than the head and body, 2 had the tail equal to the head and body, and in 16 it was shorter. In 39 males from the same locality 1 had a tail larger, 1 had a tail of the same length as, and 37 had a tail shorter than the head and body.

The legs are not especially stout. There are four intercostal spaces between the appressed toes.

The length of the head is four and a half to five and a half in the length of head and body. The head width is five to six in the length of head and body.

I have seen no specimens of this form with the skin of the head rugose. The fact that I have seen no specimens from the North Carolina mountains may have some bearing on this point.

The tubercle canthus oculi is uniformly present. The male mandible is evenly and fully provided with teeth, but the outline of the jaw is strongly flexuous and serves as a very certain and easy means of distinguishing the sexes when adult.

The costal grooves are usually 14 in number.

The color of this species had best be described from the standpoint of development. The larval coloration is the key to that of the

[1] These measurements apply to specimens from southeastern Pennsylvania, from which region over 250 specimens have been available. The species averages smaller in the north and largest in North Carolina.

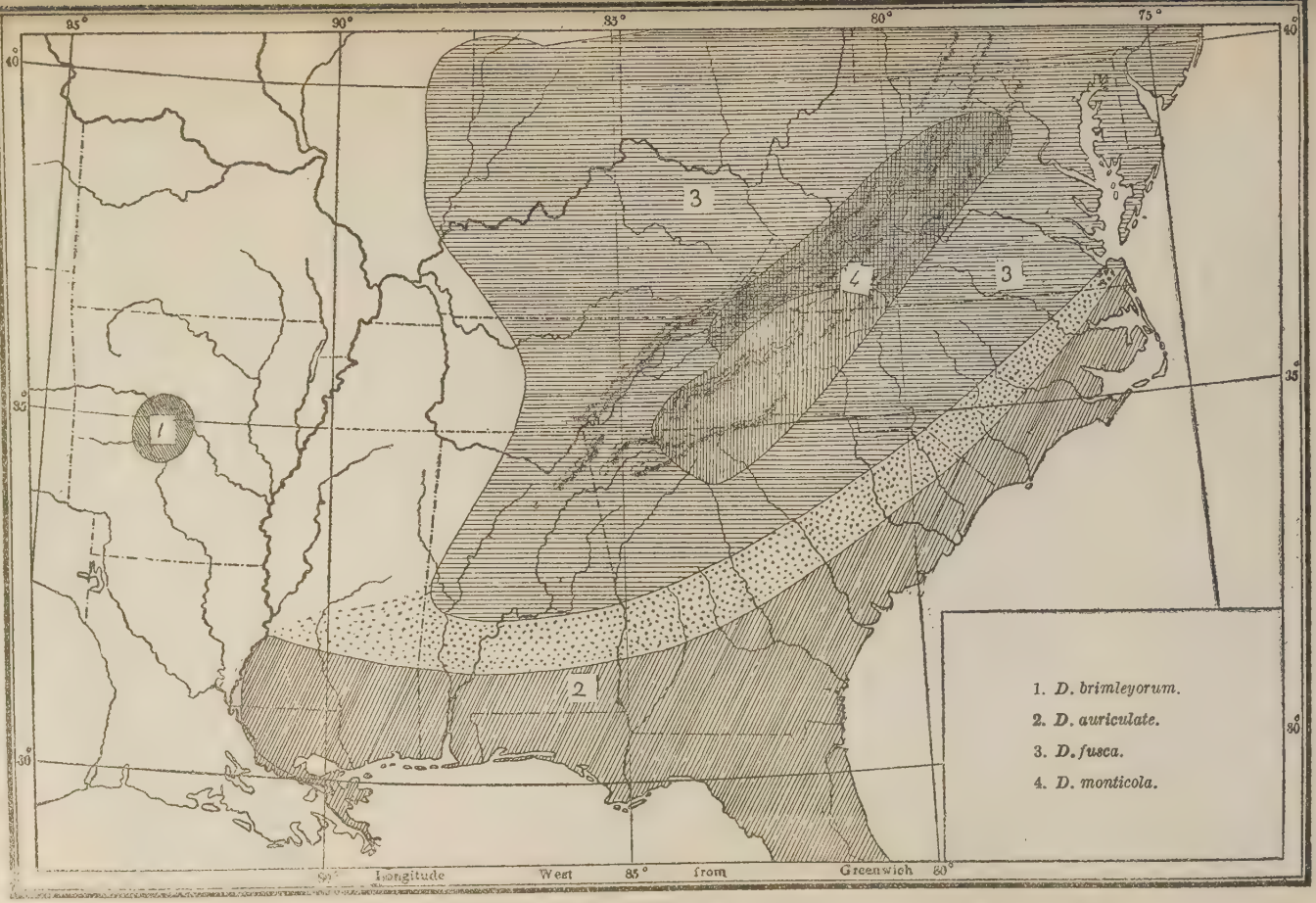


FIG. 14.—RANGES OF 1, DESMOGNATHUS BRIMLEYORUM; 2, D. FUSCA AURICULATA; 3, D. FUSCA FUSCA; 4, D. MONTICOLA.
[Note that in Virginia and West Virginia the ranges of *fusca* and *monticola* overlap, while *fusca* is absent from a large area in the North Carolina mountains. Dotting shows area of intergradation.]

adult. The ventral surface of the larva is unpigmented. The dorsal pigmentation is uniform save for a row of uncolored areas on each side of the middorsal line. These are the larval areas of Banta and McAtee (1906) and are quite as significant in the development of the color pattern of *Desmognathus fusca* as they are in that of *Spelerpes maculicaudus*.

These pigmentless areas are in pairs on the body. They are confluent on the tail. At about the time of transformation the areas on the body become confluent and the result is a light dorsal band with crenulate edges. The sides below the crenulates are mottled and the mottling, shortly after metamorphosis extends over the ventral surface. The ground color which is not present in the larvae appears at metamorphosis.. It is extremely variable, becomes darker with age and appears to be chiefly responsible for the blackness of the whole upper surface in the old specimens. In young examples it may be yellow or red. The sides of the tail are mottled much as are the sides of the body.

The sexual differences in dentition, proportions of tail, and outlines of jaw have already been treated. Aside from this the male is larger than the female. The disparity in size is great. The largest male seen, from Raleigh, North Carolina, was 134 mm. total length. Head and body, 68 mm. The largest female seen, from Nelson County, Virginia, was 107 mm. total length. Head and body, 52 mm.

Habits.—The habits of *fusca* have received much attention and are quite well known. They seem to rarely enter the water, although they live in its immediate proximity. They take advntage of holes and burrows of other animals, but are able to make their own. They lie in these burrows with the head toward the entrance.

Mrs. Wilder (1913) says, "The ideal environmental conditions for *Desmognathus fusca*, as deduced from a study of those localities in which they occur in the greatest abundance, are those afforded by the banks of well shaded streams of shallow, perennially running water."

Surface (1913) and Mrs. Wilder (1913) give accounts of the food of *fusca;* Surface tabulating the contents of 235 stomachs, Mrs. Wilder of 18.

The food is composed of insects, arachnids, earthworms, snails, and isopods. Mrs. Wilder shows that cannibalism is occasionally redulged in, and that they eat their own moulted skin, as do toads and frogs. Surface found nematodes in two stomachs, but does not say whether they were parasites or not. I have found mites encysted under the epidermis in some specimens.

The life history has been thoroughly worked out by Mrs. Wilder (1913). The mating is on land, fertilization is internal and the eggs are laid on land. She gives the total number of eggs as 20, there

being usually 10 in each ovary. Her specimens were from near Northampton, Massachusetts. In a series from Haverford, Pennsylvania, females just matured at a length of 80 mm., had usually 28 eggs, while larger females up to 100 mm. had as many as 40 eggs. Cope states that 18 to 30 eggs may be found on one side.

The act of pairing has been observed in captivity on May 13. The eggs are laid from the first of June to the end of August, most being laid during July.

The eggs are guarded by the mother, who keeps herself in contact with them probably to keep them moist. They are joined together by the external membrane. The period from laying to hatching is about five weeks. When hatched the larvae measure 15 mm. There is a terrestial larval stage of 15 to 16 days. At the expiration of this period the length is about 20 mm. and the larvae enter the water.

Mrs. Wilder gives the length of 15 aquatic larvae, collected in Massachusetts during November and December, as ranging between 17 and 25.5 mm. Seventeen larvae collected November 28, in Nelson County Virginia, ranged from 21 to 29 mm.

The aquatic larval period lasts about nine months. They transform during May and June. Thus during July and August, as a rule, no larval *fusca* will be found.

Mrs. Wilder gives the largest larva seen as 33 mm., and the smallest transformed specimen as 27.75 mm. This is at Northampton, Massachusetts. At Haverford, Pennsylvania, I have found larvae as large as 44 mm., and transformed specimens as small as 32 mm.

Mrs. Wilder says: "Specimens of 68 mm. and over of both sexes are sexually mature, apparently after three years of adult life. At Haverford they reach a larger size before maturity, although the age is probably the same. Females with developed eggs are not found smaller than 75 to 80 mm. The males lose the vomerine teeth at about 85 mm. This would be coincident with sexual maturity.

Remarks.—This is the most widespread form of the genus. With its subspecies *auriculata* it covers the whole East with the exception of the mountains of North Carolina.

Specimens intermediate between *fusca* and *auriculata* have been seen from Raleigh, Magnolia, and Kinston, North Carolina, Lake Drummond, Virginia, and Columbia, South Carolina. The Lake Drummond specimen is closer to *auriculata*, the others to *fusca*.

Specimens examined: 1,925, from localities as follows:

New Brunswick.—St. John's River, 1.

Maine.—Brooklin, 5; Westbrook, 1; Rangeley, 8.

Vermont.—St. Johnsburg, 2.

Massachusetts.—Berkshire Hills, 4; Springfield, 2; Northampton, 25.

New Hampshire.—Amherst, 3.

Connecticut.—Norfolk, 2; Redding, 1.

Rhode Island.—Providence, 1.

New York.—Adirondack, 1; Westport, 36; Ithaca, 21; Orange County, 1; Catskills, 15; Highland Falls, 16; Shokan, 8; Fort Lee, 16; Garrison, 12; Van Cortlandt Park, 1; Staten Island, 24; Long Island, 43; Tupper Lake, 1; Utica, 5; Hamburg, 6; Auburn, 3; Haines Falls, Catskills, 4.

New Jersey.—Orange, 11; Trenton, 1; Schwarzwood Lake, 2; Big Timber Creek, 1; Morristown, 15; Clement's Bridge, 10; Pennsville, Salem County, 111; Montclair, 4; Scotch Plains, 6; Maplewood, 2.

Pennsylvania.—39; Philadelphia County, 208; Delaware County, 6; Haverford, 74; Montgomery County, 55; Conshohocken, 10; Chester County, 14; Waynesburg, 3; Monocacy, 3; York County, 1; Lancaster County, 71; Altoona, 2; Indiana County, 17; Tuscarora, 1; Mifflin County, 8; Perry County, 3; Lehigh Gap, 8; Northampton County, 2; Warren County, 3; Port Allegheny, 3; Brooklyn, 1; Seven Bridges, 4; Pittsburgh, 13; Clinton County, 1; Broad Top Mountain, 14; Susquehanna County, 1; Carlisle, 473; Columbia County, 1; Meadville, 30; Centerville, 1.

Delaware.—Brandywine County, 2; Greenville, 4.

Maryland.—Gloucester, 2; Brookville, 1; Laurel, 1; Great Falls, 3; Cecil County, 3; Jennings, Garrett County, 1; Mount City Gap, 1.

Virginia.—Bailey's X-roads, 2; Fort Myer, 5; Munson's Hill, 1; Four-mile Run, 5; Fairfax County, 10; Stony Man Mountain, 21; Clarke County, 2; Berry's Ferry, Clarke County, 27; Giles County, 9; Somerset Beach, 1; Rockbridge County, 1; Bedford County, 3; Augusta County, 11; Newport News, 2; Nelson County, 33.

Ohio.—Cincinnati, 15; Columbus, 10; Highlands County, 4.

Indiana.—Richmond, 14; Brookville, 1; Jefferson County, 18.

Illinois.—Normal, 3.

West Virginia.—Kegley, 6; Big Spring Run, 1; Rich Mountain, near Beverly, 3.

Kentucky.—Morgan County, 3; Edmonson County, 1.

North Carolina.—Salem, 10; Kinston, 5; Magnolia, 2; Raleigh, 43; unknown locality, 1; French Broad River, 1; Ahseville, 9.

Tennessee.—1; Franklin County, 3; Knoxville, 3; Greenville, 1; Clearbon, 1; Athens, 1; Hamilton County, 6.

South Carolina.—Abbeville, 11; Columbia, 14.

Georgia.—Thompson's Mills, 1; unknown locality, 1.

Alabama.—Eutaw, 5; Dayton, 1; Auburn, 1.

No locality.—125.

DESMOGNATHUS FUSCA AURICULATA (Holbrook).

1838. *Salamandra auriculata* HOLBROOK, N. Amer. Herp., ed. 1, vol. 3, p. 115, pl. 28.

1849. *Desmognathus auriculatus* BAIRD, Journ. Acad. Nat. Sci., Philadelphia (n. s.), vol. 1, p. 286.

1854. *Cylindrosoma auriculatum* DUMÉRIL and BIBRON, Erpétologie Générale, vol. 9, p. 81.

1858. *Plethodon auriculatum* HALLOWELL, Journ. Acad. Nat. Sci., Philadelphia, (n. s.) vol. 3, p. 344.

1869. *Desmognathus fusca* var. *auriculata* COPE, Proc. Acad. Nat. Sci., Philadelphia, p. 116.

Type.—Not known to exist.

Type-locality.—Riceboro, Georgia.

Distribution.—From the Atlantic coast south of Dismal Swamp to Miami, Florida, and Washington, Mississippi. Zonal range: Lower Austral. Vertical range: Sea level to between 100 and 500 feet.

Diagnosis.—Similar to *fusca*, but a row of light spots on sides, slimmer, belly mottled, dark.

Description.—Vomerine teeth as in *fusca*. Parasphenoid patches shorter, separated from the vomerines by twice the length of one of the vomerine series. Tail similar to that of *fusca*, but slightly longer. The appressed toes fail to meet by four to four and a half intercostal spaces. The head length is from four to four and a half in the length of head and body. The head width is five and two-thirds to six in the length of head and body. The size is smaller than in *fusca*. The legs are weak and the tail is long. The head is narrower than in *fusca*.

The color is like that of *fusca*, but generally darker, especially ventrally. The belly, however, is always mottled. There is a line of light spots along the sides just above the insertion of the legs. This line is continued into the tail. The light spot between the eye and the angle of the jaw is especially noticeable in this form. It is said that these light spots are red in life. I have seen only alcoholics in which the color had faded.

Habits.—Nothing has been published on the habitat, food, or life history of this form save Lönnberg's (1894) statement that he found one in Florida "under a log in a wet hammock."

Its habits are probably similar to those of *fusca*. No larvae have been seen. The males lose the vomerine teeth at a length of about 90 mm., head and body 45 mm.

Remarks.—Intergrades with *fusca*. Its relationships with *fusca* have been discussed under that form.

Specimens examined: 74, from the following localities:

Virginia.—Lake Drummond, 1.

North Carolina.—Wilmington, 3; Lake Waccamaw, 5; Beaufort, 10.

South Carolina.—Unknown locality, 2; Manning, 1; Oakley, 9.

Georgia.—Unknown locality, 14; Savannah, 2; Nashville, 1; Riceboro (type-locality), 12.

Florida.—Jacksonville, 3; Green Cove Springs, 2; Miami, 1.

Alabama.—Coden 1; Mobile, 3.

Mississippi.—Unknown locality, 2; Washington, 1.
Louisiana.—Covington, 3; Clinton, 1; Mandeville, 1.
No locality.—Eight.

DESMOGNATHUS BRIMLEYORUM Stejneger.

1895. *Desmognathus brimleyorum* STEJNEGER, Proc. U. S. Nat. Mus., vol. 17, p. 598.

Type.—Cat. No. 22157, U.S.N.M. Collected by B. L. Combs, in 1894.
Type-locality.—Hot Springs, Arkansas.
Distribution.—Known only from the type-locality and Little Rock, Arkansas, Lower Austral Zone; altitude 500 to 1,000 feet.
Diagnosis.—Similar to *fusca*, but larger and much slimmer, with a row of light spots on sides as in *auriculata*, and belly mottled very pale. Tail keeled above. Vomerine teeth lacking in mature males. Transformed specimens: Total length 42–129 mm., females, 134 mm. males; head and body 27–71 mm., females, 82 mm., males.
Description.—Vomerine teeth lacking in mature males. When present they form two arched series, which contain 6 to 7 teeth each.

The parasphenoid series are quite variable. Long and narrow in small specimens; in adults they are usually short and thick and sometimes confluent anteriorly.

The tail is like that of *fusca*, but flatter and more finned above. The tail is always a good deal shorter than the head and body.

The head length is from 4 to 4½ in the length of head and body. The head width is from 5 to 6 in the length of head and body. The absence of the gular fold and the grooves of the face are noticeable only in the type series and are due to faulty preservation. More recent specimens show the gular fold and the facial grooves as well as any of the other species.

The mandibular dentition is as in *fusca*. The outline of the lower jaw is not so flexuous in the male and the glandular prolongation of the lower jaw is very weak. There is a noticeable difference in size between the males and females. There is always a tubercle canthus oculi. The costal grooves are 14 and rarely 15. There are 4 to 4½ intercostal spaces between the appressed toes.

This form has a narrow head, long slim body, short tail, and weak legs.

The color is much like that of *auriculata* on the dorsal surface. The lateral series of light spots are, however, heavily outlined with dark. The belly is mottled, but is paler than the belly of *fusca*.

Habits.—Strecker (1908) gives the following on *brimleyorum*, taken chiefly from the notes of B. L. Combs, who first collected them: "Combs's first specimens were found under the edges of flat rocks in the middle of a rather sluggish stream. Afterwards others were

found under planks, logs, and rocks, in damp woods in close proximity to water." They "would run at the slightest alarm."

Hurter and Strecker (1909) speak of *brimleyorum* eating specimens of *Spelerpes multiplicatus* with which they were confined.

No larvae have been seen. Strecker (1908) quotes from Combs's notes on the breeding habits: "In the latter part of August or early in September the female triton deposits her eggs, which are from 30 to 36 in number, and attached together in strings, in a crevice in the under side of a rotten log, or in a mass of decaying wood near some small stream. The eggs are about an eighth of an inch in diameter. The female is much attached to her eggs and seldom goes far away from them. During a dry spell she will carry them down into her hole with her, and if it rains again before they are hatched will bring them again to the surface." The life history is probably closely similar to that of *fusca*. The males lose the vomerine teeth at a length of about 95 mm.

Remarks.—This species and *auriculata* are the only forms of the genus that possess the lateral row of light spots. They are also the two slimmest forms with the weakest limbs. These facts and the geographical probabilities indicate that *brimleyorum* is a distinct, isolated, offshoot of *auriculata*.

Specimens examined.—37, from the following localities:

Arkansas.—Hot Springs (type-locality), 24; Little Rock, 12.

No locality.—1.

DESMOGNATHUS OCHROPHAEA OCHROPHAEA Cope.

1859 *Desmognathus ochrophaea* COPE, Proc. Acad. Nat. Sci., Philadelphia, p. 124.

1870 *Desmognathus haldemanni*[1] STRAUCH, Mém. Acad. Sci., St. Pétersbourg (7), vol. 14, p. 204.

1901 *Desmognathus fusca* ALLEN, Proc. Boston, Soc. Nat. Hist., vol. 29, pp. 73–74.

Type.—According to Stejneger, Cope's type of *ochrophaea* is catalogued in the United States National Museum as 4539. This entry bears in Baird's handwriting "type of supposed new species, *D. ochrophaea* Cope" and also in Cope's handwriting the one word "Destroyed."

Type-locality.—Susquehanna County, Pennsylvania.

Distribution.—From St. Johns River, New Brunswick and Adirondack Mountains, New York, south in the mountains to Garrett County, Maryland. Canadian zone.

Diagnosis.—Vomerine teeth lost in adult male. Parasphenoid patches separated. Tail cylindrical, without dorsal keel. A distinct color pattern. Belly, uniform, light. No tubercle canthus oculi. Transformed specimens: Total length, 22.5 to 94 mm. Head and body, 15 to 48 mm.

[1] *Salamandra haldemanni* Holbrook is judging from the plate a specimen of *Spelerpes bislineatus* in some stage of the metamorphosis. The gills are lacking, but in color and proportions it is an exact duplicate of certain metamorphosing larvae of *bislineatus* collected in August.

Description.—Vomerine teeth in a scarcely arched series, their base on a bony ridge. Parasphenoid series long, narrow, and entirely separate.

Mandibular dentition of adult male as follows: The teeth are large and confined to the part of the jaw anterior to the eye. The outline of the jaw is very strongly flexuous.

The tail usually shows no trace of a dorsal keel, but is cylindrical throughout and marked by strong segmental grooves as in the tail of *Plethodon erythronotus*. The tail is quite long proportionally, being frequently longer than the head and body. The tail of the female is longer than that of the male. Males reach a larger size than do females. The number of costal interspaces between the appressed toes is four.

The head length is from four to four and a half in the length of head and body. The head width is from five and a half to six in the length of head and body. The skin of the head is smooth. There is usually no tubercle in the anterior angle of the eye. By far the great majority of specimens seen lack it, but it is present in four specimens from Shokan, New York. The costal grooves are regularly fourteen. The color of this form is quite constant. The belly is always very light. The dorsal surface in old and large specimens is black. In all specimens in which the markings can be made out the dorsal surface is very light and there is a very dark, broad lateral band. The upper edge of this lateral band is straight and definite. The lower edge is indefinite, as the band gradually merges into the pale color of the ventral surface. Sometimes there are a few small spots along the median dorsal line. This occurs in medium and large specimens. Young specimens have the dorsal area immaculate and the color of it may be pink or yellow.

There is never any trace of the dorsal spots so conspicuous in the young of most other species of the genus. The black lateral band extends the length of the tail as does the light dorsal band, and the color of the tail is quite as characteristic of this species as is the shape of the tail.

Habits.—Cope (1889) claims that *ochrophaea* is strictly terrestrial, being found "under the bark of every fallen log of hemlock (*Abies canadensis*) and in the débris of the dark, damp forests of the North. I never saw one in the water of streams and river banks, the habitat of the other species of the genus."

Fowler (1906) gives an account of the habits of this species. Unfortunately he did not distinguish between this species and *fusca*, but of the 316 specimens in the Academy of Natural Sciences, collected by him in Potter and McKean Counties, Pennsylvania, 308 are *ochrophaea* and 8 are *fusca*. He says: "It was found everywhere in the valleys, about and in streams, and on the comparatively dry mountain tops,

though there less numerous and more solitary." Thus while *ochrophaea* can not be said to be strictly terrestrial, it seems more so than the other forms.

Cope says that the eggs are 6 to 10 in each oviduct. A large female from Potter County, Pennsylvania, had 10 on one side and 14 on the other. No larvae have been seen. Judging by the more terrestrial habitat, and the lack of the light dorsal spots, which are a larval character, the life history should differ from that of *fusca*. The males lose the vomerine teeth at a length of 65 to 75 mm. Females the same size have developed eggs.

Remarks.—This seems to be a northern offshoot of the next form. It is the only form in the genus which lacks the tubercle canthus oculi. Records and specimens from Ohio seem open to doubt. There are four very old specimens in the United States National Museum, numbered 3896, from Columbus, Ohio. Morse (1904) records it from Sugar Grove, Ohio. U. S. National Museum specimen 15634 from "S. Arizona and Texas," is even more open to doubt.

Specimens examined, 480, from localities as follows:

New Brunswick.—St. Johns River, 1.

New York.—Westport, 4; Catskills, 1; Allegheny County, 5; Shokan, 4; Hamburg, 8; Ithaca, 18; Haines Falls, Catskills, 12; Clinton County, 6.

Pennsylvania.—Meadville, 24; Indiana County, 12; Clinton County, 4; Broad Top Mountain, 3; Luzerne County, 17; Eagles-mere, 4; Susquehanna County (type-locality), 5; Potter County, 253; McKean County, 55; Warren County, 11; unknown locality, 24.

New Jersey.—Greenwood Lake, 1.

Maryland.—Garrett County, 11.

Ohio.—Columbus (?), 4.

"S. Arizona and Texas" (?), 1.

No locality.—3.

DESMOGNATHUS OCHROPHAEA CAROLINENSIS Dunn.

1916. *Desmognathus ochrophaea carolinensis* DUNN, Proc. Biol. Soc. Washington, vol. 29, p. 74.

Type.—Cat. No. 31135, U.S.N.M. Male adult. Collected by Brimley and Sherman, October 5, 1902.

Type-locality.—Mount Mitchell, North Carolina, spring near top, altitude "over 6,500 feet."

Distribution.—From Beverly, West Virginia, south in mountains to Gwinnett County, Georgia. Zonal range: Canadian zone. Vertical range: 2,200 to 6,500 feet.

Diagnosis.—Similar to *ochrophaea*, but with dark belly, and with a tubercle canthus oculi. Larger. Transformed specimens: Total length 25 to 113 mm; head and body, 54 mm.

Description.—The vomerines are always present in the female. They are lost by the male at maturity. Their shape and position as well as those of the parasphenoid series is as in *ochrophaea*.

The mandibular dentition is as in *ochrophaea*, save that the female has a more flexuous outline of the jaw than does the female in that

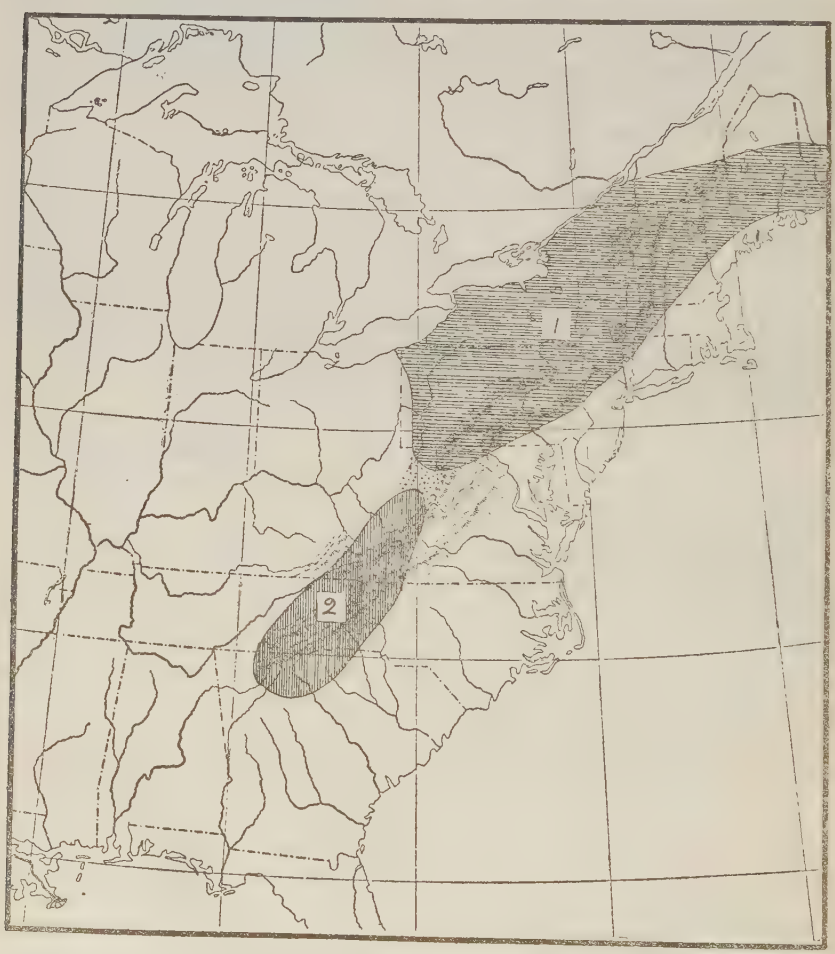


FIG. 15.—RANGES OF 1, DESMOGNATHUS OCHROPHAEA OCHROPHAEA; 2, D. OCHROPHAEA CAROLINENSIS. DOTTING SHOWS AREA OF INTERGRADATION.

species. The shape and proportions of the tail are just as in *ochrophaea*. There are 14 costal grooves. The proportions of the head are those of *ochrophaea*. There is always a tubercle canthus oculi. The skin of the head is usually finely rugose as in specimens of *quadrimaculata* and *monticola* from the North Carolina mountains.

The color is variable. Old specimens are uniformly black. As a rule the dorsal color is intermediate between that of *ochrophaea* and that of the *fusca* group. Thus there is a very dark lateral band

with sharply defined dorsal edges, but the back shows traces of an original series of light dorsal spots. The blackness of the sides of the tail is as characteristic of this form as of *ochrophaea*. Unlike *ochrophaea* the belly of *carolinensis* becomes black with age.

Remarks.—Although close to *ochrophaea* and undoubtedly intergrading with it in the mountains of northern West Virginia, this form tends toward the other species of the genus, with its dark belly and tubercle in the anterior angle of the eye.

This is a very variable and puzzling form. Some specimens are exactly like Northern *ochrophaea* in color; others are spotted. In these the dorsal coloration may be red or yellow. Most of the larger specimens are uniform purplish.

There is an unmistakable trend toward *fusca* in specimens from the French Broad Valley at Brevard. This is doubtless correlated with the difference in habitat from mountain specimens mentioned below. At Asheville in the French Broad Valley, *fusca* occurs.

It is quite possible that intergradation takes place, but until it is proved, I think it best to let *carolinensis* stand as a subspecies of *ochrophaea* because I believe *ochrophaea* to be derived from *carolinensis* rather than from *fusca*. At any rate the form *carolinensis* is between the form *fusca* and the form *ochrophaea* in characters.

Brevard *carolinensis* are much smaller than *fusca;* their coloration is like that of the mountain specimens in frequently having the immaculate dorsal stripe which *fusca* does not have; the tails of about half the specimens are cylindrical, half have the tail somewhat flattened, and a few of the smallest have a dorsal keel on the tail. Typical *fusca* has a decidedly flattened tail with an evident dorsal keel. Asheville specimens are like ordinary *fusca*, but seem slightly smaller.

Cope (1889) mentions this form as a variety of *ochrophaea*.

Habits.—In the low grounds of the French Broad River at Brevard, North Carolina, I found them in such places as *monticola* or *fusca* would frequent; but they rarely occurred with *monticola*, as the latter did not range into the low grounds. Higher up in the mountains, at Pink Beds and Linville *carolinensis* is almost wholly terrestrial. But occasional exceptions were found. Thus at Linville they were found everywhere from under a rock in water to under the bark of a tree five feet from the ground. By far the greater number, however, were under logs on the ground.

I found two females with eggs in July. They had 10 to 15 eggs apiece, a very small batch compared with the 30 eggs of average *fusca*.

No larvae have been seen and it is somewhat doubtful whether there is any definite aquatic larval stage.

The males lose the vomerine teeth at a length of 65 to 75 mm.

The largest specimen in the list of measurements must be a veritable giant, for out of a series of 213 which I got myself, the largest was 96 mm. in length.

Specimens examined: 296, from localities as follows:

Georgia.—Gwinnett County, 1; Tallulah Falls, 1.

North Carolina.—Mount Mitchell (type-locality), 19; Blantyre, 3; Highlands, 2; Brevard, 40; Pink Beds, 28; Tatula Mountain, 2; Andrews, 1; Wayah Bald, 2; Henderson County, 1; Haywood County, 11; Bald Mountain, Macon County, 1; Black Mountains, 8; Yancey County, 1; Cane River, 7; Pineola, 1; Linville, 135; Blowing Rock, 1; Roan Mountain, 8.

Tennessee.—Roan Mountain, 15.

West Virginia.—Star Creek, 1; Big Spring Run, 3; Rich Mountain, near Beverly, 1.

Genus LEUROGNATHUS Moore.

1899. *Leurognathus* MOORE, Proc. Acad. Nat. Sci. Philadelphia, 1899, p. 316.

Type-species.—*Leurognathus marmorata* Moore.

Diagnosis.—General characters of the Plethodontidae. Tongue attached, except by its lateral and posterior margins. Prefrontal bone wanting. Premaxillaries united, no fontanelle. Internal nares a foramen inclosed by the united vomers and maxillaries. Vertebrae opisthocoelous in the adult. Atlas without odontoid process and with a transverse dorsal ridge on which the temporal muscles originate. Occipital condyles on cylindric pedestals. Vomerine teeth not present. No light line from the eye to the angle of the jaw.

Distribution.—Same as that of the type-species.

LEUROGNATHUS MARMORATA Moore.

1899. *Leurognathus marmorata* MOORE, Proc. Acad. Nat. Sci. Philadelphia, 1899, p. 316.

Type.—Academy of Natural Sciences. Young male. Collected by Doctor Moore.

Type-locality.—Grandfather Mountain, North Carolina, stream between Linville and Blowing Rock, elevation about 3,500 feet.

Distribution.—Known only from the type-locality and from Roan Mountain, North Carolina.

Diagnosis.—No vomerine teeth. Legs stout. Two and a half to three intercostal spaces between appressed toes. Tail flattened, keeled and finned above. Head very large. Size large. No distinct color pattern. Belly black in old specimens. The total length of the five known specimens ranges from 98 to 128 mm. The length of head and body from 55 to 75 mm.

Description.—No vomerine teeth. The parasphenoid teeth form two leaf-shaped series which touch at the anterior end and are posteriorly distant.

The tail is shorter than the head and body, flattened and finned above and to a less extent below.

The head length is about four and a half in the length of head and body. The head width is about five and a half in the length of the head and body. In the Roan Mountain specimen the head is rugose like grain leather. In the type the head is quite smooth. The legs are stout. In the four from Grandfather Mountain there are two and a half intercostal spaces between the appressed toes. In the Roan Mountain specimen there are three. The costal grooves are 13, counting the axillary and inguinal. They are as in most *quadramaculata*. The color is much like that of *quadramaculata*, save that the dorsal coloration is lighter. The pattern is confused, but usually there is a double dorsal row of light spots without any definite borders. This coloration is intermediate between that of *D. quadramaculata* and that of *D. monticola*. The three smaller ones have the belly light while the two larger ones have it black. No sexual differences are evident.

I refer one larva caught in Grandmother Creek just below the lake to this species.

Moore's statement that *L. marmorata* is more aquatic than *Desmognathus quadramaculata*, the absence of adults or larvae in small streams near Linville which we searched thoroughly, and this larva from Grandmother Creek, all go to show that this species inhabits large streams. On several occasions we noticed salamanders in the Linville River. All those we could catch, however, turned out to be *Desmognathus quadramaculata*.

The larva shows Desmognathine affinities in its stout hind legs, glistening white gills, and dorsal fin only on the tail. No larvae known have all these characters save those of *Desmognathus*. It is much too large (63 mm.) for *monticola*, which transforms at 30 mm., or *carolinensis* which is even smaller.

In size and general appearance it agrees with larvae of *quadramaculata* collected at Brevard and Linville. It differs, however, in the much longer tail, the shorter and slimmer head, and the slimmer body.

Compare the proportions of several larvae:

	Length.	Head.	Body.	Tail.
	mm.	*mm.*	*mm.*	*mm.*
Leurognathus marmorata	63	8	24	31
Desmognathus quadramaculata	48	6	22	20
Do	52	8	23	21
Do	55	8	24	21
Do	59	9	25	25
Do	63	10	26	27
Do	63	10	31	22

The eyes are larger and farther apart. The head of a *quadramaculata* larva bears more resmblance to that of a pig, while this unique larva rather resembles a squid with its great staring eyes.

The color is much darker, although the pattern seems about the same. There is no light line from the eye to the angle of the jaw which line is quite evident in both larval and adult *quadramaculata*. Finally, the under side of the throat is pigmented, reminding one of the larva of *Gyrinophilus danielsi*. The throat of *quadramaculata* larvae is unpigmented.

While I think there can be no doubt that this larva is distinct from *D. quadramaculata*, I hesitated for some time before referring it to *Leurognathus marmorata*. *L. marmorata* differs very slightly in proportions from *D. quadramaculata*, and the color is usually lighter, especially in young specimens. Thus the larva would seem to differ from *marmorata* more than *quadramaculata* does. However there are only two possibilities; either this is the larva of *L. marmorata*, an animal known only from five specimens, four of which are from the Atlantic drainage on the slopes of Grandfather Mountain; or there exist in the Atlantic drainage on the slopes of Grandfather Mountain, two rather aquatic salamanders, much resembling *D. quadramaculata*, and known only from four adults and one larva, respectively.

Habits.—Nothing is known of their breeding habits. Doctor Moore says of them: "They seem to be essentially aquatic, remaining in the deeper parts of the pool and not burrowing beneath stones in places merely wet, as does the *D. nigra*, which occurs in great numbers in the same region. *L. marmorata* is much less active than the latter species and swims rather sluggishly, but with an easy gliding motion. The individuals seen seemed rather shy, and when alarmed quickly took refuge under the large rocks scattered through the pool, from beneath which, however, they were easily induced to emerge by the attraction of pieces of meat thrown into the water."

Remarks.—This species is externally very similar to *D. quadramaculata*, especially the two larger specimens, which are black. The flatness of the head is a very noticeable external character. I was looking over the specimens of *Desmognathus* in the collection of the academy, and one looked as if its head had been stepped on. It proved to be the Roan Mountain specimen of *Leurognathus*. This species is excessively rare and has had a rather curious history, as two out of the six known specimens have passed the time since the late nineties, when they were collected, under the name of *D. nigra*. Rhoads's specimen from Roan Mountain was collected in 1895, four years before the genus was described. Doctor Moore, who described the genus from three specimens, had four in his collection, but the resemblance of the adult to *D. quadramaculata* deceived him, as it had Rhoads.

Specimens examined from localities as follows:

North Carolina.—Stream between Linville and Blowing Rock, about 10 miles from the latter (type locality), 3; Blowing Rock, 1; Roan Mountain, 1; Pineola, 1.

DISCUSSION OF THE ORIGIN OF THE VARIOUS FORMS.

Adams (1902) gives 10 criteria for determining the center of dispersal of a related group of animals. These are:

1. Location of greatest differentiation of a type.
2. Location of dominance or great abundance of individuals.
3. Location of synthetic or closely related forms.
4. Location of maximum size of individuals.
5. Location of greatest productiveness and its relative stability.
6. Continuity and convergence of lines of dispersal.
7. Location of least dependence upon a restricted habitat.
8. Continuity and directness of individual variations or modifications radiating from the center of origin along the highways of dispersal.
9. Direction indicated by biogeographical affinities.
10. Direction indicated by the annual migration routes in birds.

The last is, of course, inapplicable in this instance.

In regard to the first criterion it has been shown that the three groups of *Desmognathus* occur together only in the southern Alleghenies.

In regard to abundance, Moore's already quoted remarks on *quadramaculata* apply, and Brimley (1912) says of *carolinensis*, "abundant throughout the regions collected in, particularly at the high altitudes" and of *quadramaculata* (with which he included *monticola*), "abundant, the most characteristic salamander of the rocky, mountain streams."

As to the third criterion, *monticola* and *carolinensis* are closer to *quadramaculata* than are any other members of their groups. *Quadramaculata* is the largest species in the genus, and *monticola* and *carolinensis* are the largest in their groups.

It has been shown that productiveness, judged by the number of eggs, is, in *fusca*, dependent on size. The largest *fusca* seen are from North Carolina, and in the mountains of that State occurs *monticola*, a close relative of *fusca*, and still larger.

The sixth and ninth criteria are closely similar and may be treated together. The dispersal of the *ochrophaea* group seems to have been northward along the mountains. The *fusca* group took the plains route radiating from the mountains as *fusca* and southward along the coast as *auriculata*. An isolated trans-Mississippi form of the latter has developed into *brimleyorum*. In Virginia and northward *fusca* has invaded the mountains into the range of *monticola*. It

seems to have originated eastward and gone around the mountains in Georgia and across them in northern Virginia and Pennsylvania. This convergence from two sides may account for the apparent absence of *fusca* in western Kentucky, western Tennessee, and northern Mississippi.

As to the seventh criterion, *Desmognathus* is found in the mountains of North Carolina in all situations; from far out in streams as large as the Linville River to under the bark of dead trees 5 feet from the ground.

The eighth criterion is satisfied by the southward increase in the size of *fusca* already referred to. If we arrange the species in the following order:

$$quadramaculata\text{–}monticola\text{–}fusca\begin{cases} auriculata\text{–}brimleyorum, \\ carolinensis\text{–}ochrophaea, \end{cases}$$

we shall get by starting with *quadramaculata* definite and continuous variation in several characters; in size and importance of the dorsal larval areas, ending with the striped *ochrophaea;* in the size and importance of the lateral larval areas, ending with *brimleyorum;* in the hooking of the male mandible, ending with *ochrophaea;* in the shortening of the parasphenoid patches ending with *brimleyorum;* in the loss of the male vomerines and the shortening of the series in both sexes (not much change in this character or in that of discrepancy in size between the sexes takes place after *fusca* is reached); in the weakening of the limbs and the lengthening of the body, ending with *brimleyorum;* in terrestrialism, ending with *ochrophaea.*

In the series ending with *brimleyorum* there is geographic continuity from the southern Alleghenies to Arkansas, but in the series ending with *ochrophaea* we apparently leave the mountains to develop *fusca* and enter them again to obtain *carolinensis.*

As an hypothesis to account for this peculiar distribution the following is put forward with considerable diffidence, as it rests on no fossil evidence:

C. C. Adams states that during the last glaciation there existed south of the ice first a tundra belt, then a coniferous forest, and lastly a deciduous forest. Now *monticola* and *fusca* are in general restricted to deciduous forests. We may place their glacial distribution as the glacial deciduous forest—*monticola* in the uplands and *fusca* in the lower land.

Possibly at this time *auriculata* and *brimleyorum* were developed in the extreme south, but more probably their differentiation is postglacial.

During the last glaciation specimens of *fusca* invaded the glacial coniferous forest, acquiring less aquatic habits and an adaptation to a lower temperature, thereby or therewith being converted into *carolinensis.*

Morphologically, as I have shown, *carolinensis* is derived from *fusca*. Ecologically, while *fusca* and *monticola* have apparently similar habitats, actually the climate of the range of *monticola* is more humid that that of the range of *fusca*. Consequently, in degree of aquatic habitat, *fusca* is between *monticola* and *carolinensis*.

With the retreat of the ice *carolinensis* followed the coniferous forest to the southern mountains, where they both remain. Northern representatives of the form have developed into *ochrophaea*.

Monticola also retreated to the mountains because of the greater humidity. It now occupies the deciduous forest in the transition zone in the southern mountains.

Postglacially also occurred the overlapping of the ranges of *fusca* and *monticola*. It matters not whether we assign the differentiation of these two closely related, ecologically similar, forms to the period preceding the last glaciation or to that of the ice itself. At any rate, we are compelled to hypothesize for them ranges originally adjacent but distinct, differing in that the range of *monticola* was more humid. Perhaps it will best suit the facts of differentiation to suppose that prior to the last glaciation *monticola* occupied the mountains and *fusca* the piedmont and coastal plain.

It is highly probable that the entire extension of the genus west of the Appalachian Valley is postglacial, as neither *monticola* nor *quadramaculata* are known from the Cumberlands.

There are indications, such as the apparent isolation of *brimleyorum* in Arkansas and the rarity and disconnected range of *fusca* in Indiana and Illinois, that in early postglacial times forms of *Desmognathus* extended farther west than now. In this connection the remarks of Gaines (1895) on the recent extinction of *fusca* near Vincennes, Indiana; of McAtee (1907) on its former presence in Monroe County, Indiana; and Hahn's (1908) failure to find it in Lawrence County, Indiana, are of interest. It should be noted that failure to find *fusca* is of much greater significance than failure to find most other species of reptiles and amphibians, for where it is present it is much the commonest salamander.

For the differentiation of *monticola* from *quadramaculata* we do not need to assume a distinct geographic range, as they are ecologically different. But we are compelled to place the time of differentiation at a more remote period than that of any of the other forms, because *quadramaculata* is the most primitive as well as the most distinct form in the genus.

The above is only a hypothesis, and only in so far as it accounts for the known facts of distribution and relationship is it worthy of consideration. If it incites discussion and criticism the author will be well pleased.

Besides these arguments drawn from the species of *Desmognathus*, it is significant that in the southern Alleghenies occurs the only

species of the only closely allied genus, *Leurognathus marmorata*. I think I am justified by the above evidence in locating the center of dispersal of *Desmognathus* in the southern Alleghenies.

MEASUREMENTS IN MILLIMETERS.

DESMOGNATHUS QUADRAMACULATA (HOLBROOK).

Specimen.	Sex.	Length.	Head.	Body.	Tail.	Vomerine teeth.	Spaces between toes.[2]	Locality.
U.S.N.M. 3923	Male	151	.....	[1] 100	50	.....	.....	Abbeville, S. C.
U.S.N.M. 3923	do	157	22	60	75	.....	.....	Do.
U.S.N.M. 14419	do	112	17	61	44	6-6	2½	Wytheville, Va.
U. of Pa.	do	135	20	60	49	3-3	2½	Blowing Rock, N. C.
U.S.N.M. 30901	Female	133	18.5	58.5	56	.....	.....	Linville, N. C.
U. of Pa.	do	129	17	57	55	.....	.....	Blowing Rock, N. C.
A.N.S. 915	.....	125	18	56	51	3-3	3	Henderson Co., N. C.
E.R.D.	Male	129	17	55	57	4-3	2	Haywood Co., N. C.
Do	do	121	17	54	49	8-8	2	Do.
A.N.S. 923	do	115	15	56	44	7-7	2½	Giles Co., Va.
A.N.S. 917	do	129	18.5	54.5	56	3-3	2½	Do.
A.N.S. 918	do	119	16	54	49	7-7	2½	Do.
E.R.D.	do	122	17	54	51	3-3	2	Grandfather Mt., N. C.
Do	Female	104	16	53	35	6-8	2½	Haywood Co., N. C.
A.N.S. 916	Male	119	16	50.5	49	7-7	2½	Giles Co., Va.
A.N.S. 920	Female	115	15	49	51	6-6	3	Do.
E.R.D.	do	92	14.5	45.5	32	6-4	2	Haywood Co., N. C.
A.N.S. 919	Male	105	16	44	45	5-4	.....	Giles Co., Va.
E.R.D.	do	94	11	38	45	5-5	2½	Haywood Co., N. C.
A.N.S. 913	.....	92	14	43	35	3-4	3	Henderson Co., N. C.
A.N.S. 921	Female	73	13	37	23	5-5	3	Giles Co., Va.
A.N.S. 922	do	81	11.5	34.5	35	.....	2½	Do.
U.S.N.M.	.....	69	9	31	29	.....	3	Brevard, N. C.
A.N.S. 925	do	78	11.5	29.5	37	4-4	3	Giles Co., Va.
U.S.N.M.	Larva	65	9	28	37	.....	3	Brevard, N. C.

U.S.N.M.: United States National Museum.
A.N.S.: Academy of Natural Sciences of Philadelphia.
M.C.Z.: Museum of Comparative Zoology at Cambridge.
E.R.D.: Collection of E. R. Dunn.
A.M.: American Museum of Natural History.
Cornell: Museum of Cornell University.

[1] Head and body.
[2] Of appressed limbs.

DESMOGNATHUS MONTICOLA DUNN.

M.C.Z. 2546	Male	112	16	52	64	0	3½	Blantyre, N. C.
Cornell	do	106	14.5	51.5	40	0	.....	Clayton, Ga.
E.R.D.	do	112	15.5	48.5	48	2-4	3	Haywood Co., N. C.
Do	do	120	15	48	57	3-4	3	Do.
Do	Female	119	13.5	47.5	58	5-6	3	Blantyre, N. C.
U.S.N.M. 31116	Male	101	14	47	40	3-3	2½	Yancey Co., N. C.
U.S.N.M. 38253	do	135	14.5	46.5	74	3-2	3	Tatula Mt. near Highlands, N. C.
E.R.D.	Female	122	13	46	46	.....	3	Haywood Co., N. C.
U.S.N.M. 38251	do	104	12.5	45.5	46	.....	3	Wayah Bald Mt., N. C.
U.S.N.M. 38314	do	91	12	45	34	.....	3	Brevard, N. C.
U.S.N.M. 38313 [1]	Male	116	12	45	58	3-3	3	Do.
U.S.N.M. 38316	do	75	13	44	18	3-3	3	Do.
U.S.N.M. 31120	do	107	11.5	41.5	54	4-5	2½	Yancey Co., N. C.
U.S.N.M. 38315	Female	100	12	39	49	5-5	3	Brevard, N. C.
U.S.N.M. 31121	do	93	11.5	34.5	47	.....	3	Yancey Co., N. C.
U.S.N.M. 48455	.....	79	9	28	42	.....	2	Brevard, N. C.
U.S.N.M. 38320	.....	58	7.5	27.5	23	.....	2	Do.
U.S.N.M. 38321	.....	63	7.5	25.5	30	.....	2	Do.
E.R.D.	.....	55	7	20	28	4-5	2	Clarke Co., Va.
U.S.N.M. 38323	.....	46	7	19	20	.....	2	Brevard, N. C.
U.S.N.M. 38324	.....	36	5.5	14.5	16	.....	.....	Do.
U.S.N.M. 38325	.....	34	5	14	15	.....	.....	Do.
U.S.N.M. 38326	.....	31	5	12	14	.....	.....	Do.

[1] Type.

DESMOGNATHUS FUSCA FUSCA (RAFINESQUE).

[All measurements taken from specimens in my own collection.]

Sex.	Length.	Head.	Body.	Tail.	Vomerine teeth.	Spaces between toes.	Locality.
Male	134	14	54	66	0	4½	Raleigh, N. C.
Do	128	14	53	61	0	.....	Conshohocken, Pa.
Do	116	13	52	51	0	4	Haverford, Pa.
Do	109	14	51	44	0	4	Midway, Va.
Do	119	12	50	57	0	4	Haverford, Pa.
Do	94	12	48	34	0	4½	Do.
Do	113	13	48	52	0	4	Midway, Va.
Do	100	12	46	42	0	4	Haverford, Pa.
Do	109	11	45	53	0	4	Do.
Female	100	10	42	48	3–3	4½	Do.
Do	102	9.5	41.5	51	6–3	4	Do.
Male	104	11	41	52	0	4	Clark Co., Va.
Female	107	11.5	40.5	55	3–4	4½	Midway, Va.
Do	93	9	40	44	3–4	5	Haverford, Pa.
Male	96	10	40	46	2–2	4	Do.
Do	99	10.5	38.5	50	1–	4	Clarke Co., Va.
Female	91	9.5	37.5	44	5–6	4	Haverford, Pa.
Male	81	11	36	33	0	4	Clarke Co., Va.
Female	81	8	35	38	3–3	5	Haverford, Pa.
Male	83	9	34	40	2–2	4	Do.
Do	73	9	33	31	2–2	4	Do.
Female	81	8	32	41	5–2	4	Do.
Do	75	8	31	36	3–3	4	Do.
Male	72	9	30	33	4–5	4	Midway, Va.
Do	71	9	30	32	4–4	4	Haverford, Pa.
Do	63	7.5	28.5	27	6–6	4	Do.
Do	67	8	28	31	4–4	4	Do.
Female	62	7	28	27	.....	4	Do.
Male	65	7	26.5	31.5	6–6	4	Do.
Female	64	7.5	25.5	31	.....	4	Clarke Co., Va.
Male	61	7	25	29	4–3	4	Haverford, Pa.
Female	60	7	25	28	3–3	4	Clarke Co., Va.
Do	58	7	23	28	3–3	4	Haverford, Pa.
Male	53	6.5	21.5	25	4–4	4	Do.
Female	52	6.5	20.5	25	.....	3	Clarke Co., Va.
Do	39	6	20	13	.....	4	Haverford, Pa.
Do	43	6	19	18	.....	.....	Do.
Do	39	5	17	17	.....	.....	Do.
Do	32	5	15	12	.....	.....	Do.
Do	27.5	4.5	14	9	.....	.....	Clarke Co., Va.
Larva	44	5	19	20	.....	.....	Haverford, Pa., May 28.
Do	33.5	4.5	15	14	.....	.....	Do.

DESMOGNATHUS FUSCA AURICULATA (HOLBROOK).

Specimen.	Sex.	Length.	Head.	Body.	Tail.	Vomerine teeth.	Spaces between toes.	Locality
M.C.Z. 2783	Male	107	13	49	45	0	4½	Mobile, Ala.
M.C.Z. 1070	do	103	14	48	41	0	4½	Jacksonville, Fla.
M.C.Z. 1070	Female	99	11	45	43	6–4	4	Do.
M.C.Z. 1070	do	106	10.5	43.5	52	.....	4½	Do.
U.S.N.M. 16675	Male	86	11.5	43.5	32	0	4½	Clinton, La.
M.C.Z. 2783	Female	89	11	42	36	3–5	4½	Mobile, Ala.
U.S.N.M. 21380	Male	101	11.5	40.5	49	0	4½	Savannah, Ga.
U.S.N.M. 21379	do	90	11.5	38.5	40	0	4½	Do.
U.S.N.M. 11899	do	85	11	38	36	0	.....	Mobile, Ala.
U.S.N.M. 45920	do	101	12.5	37.5	51	0	.....	Washington, Miss.
U.S.N.M. 37086	do	100	12.5	35.5	53	0	4½	Wilmington, N. C.
M.C.Z. 1168	do	75	9.5	34.5	31	5–5	4	Beaufort, N. C.
U.S.N.M. 37085	do	78	9.5	31.5	37	4–5	4	Wilmington, N. C.
M.C.Z. 2783	do	85	8.5	31.5	45	4–3	4	Mobile, Ala.
U.S.N.M. 37084	do	74	10	29	35	4–5	4	Wilmington, N. C
M.C.Z. 1168	do	69	8.5	30.5	30	5–4	4½	Beaufort, N. C.
Do	do	60	8	27	25	3–4	4½	Do.

DESMOGNATHUS BRIMLEYORUM STEJNEGER.

Specimen.	Sex.	Length.	Head.	Body.	Tail.	Vomerine teeth.	Spaces between toes.	Locality.
M. C. Z. 2784	Male	134	17	65	52	0	5	Little Rock, Ark.
U.S.N.M.	do	128	16	58	54	0	4½	Do.
A. M. 506	Female	129	14.5	56.5	58	5–5	4½	Hot Springs, Ark.
A. N. S. 15785	do	118	14	51	53	4–3	4	Little Rock, Ark.
M. C. Z. 2784	Male	122	16	51	55	0	4½	Do.
U.S.N.M. 22165	Female	105	13	50	41	.....	.....	Hot Springs, Ark.
M. C. Z. 2539	Male	99	14	48	37	0	4½	Do.
U.S.N.M.	do	113	15	48	50	0	.....	Little Rock, Ark.
M. C. Z. 2784	do	111	14	46	51	0	4½	Hot Springs, Ark.
U.S.N.M. 38797	Female	105	12.5	44.5	48	5–7	4½	Do.
M. C. Z. 3142	do	101	13	43	45	4–4	4½	Little Rock, Ark.
U.S.N.M. 22161	do	93	12	43	38	.....	.....	Hot Springs, Ark.
U.S.N.M. 22163	do	95	12	42	41	.....	4½	Do.
M. C. Z. 2784	do	76	10	42	34	3–4	3	Little Rock, Ark.
U.S.N.M. 22169	Male	93	.....	[1] 54	39	1	.....	Hot Springs, Ark.
U.S.N.M.	Female	93	11.5	41.5	40	7–7	.....	Little Rock, Ark.
U.S.N.M. 38796	Male	93	11	40	42	4–4	3	Do.
U.S.N.M. 38798	Female	80	10	34	36	6–6	4	Do.
U.S.N.M. 38799	do	64	9.5	28.5	26	3–4	4	Do.
U.S.N.M.	.....	61	9.5	28.5	23	.....	.....	Do.
M. C. Z. 2784	Female	60	8	28	24	5–5	3	Do.
U.S.N.M. 38800	.....	59	8.5	27.5	23	7–6	3½	Do.
U.S.N.M.	.....	48	8.5	26.5	14	.....	.....	Do.
M. C. Z. 2784	.....	57	8	25	25	.....	4	Hot Springs, Ark.
U.S.N.M. 38801	.....	42	7	20	15	.....	3	Little Rock, Ark.

[1] Head and body.

DESMOGNATHUS OCHROPHAEA OCHROPHAEA COPE.

[All specimens in list from Gold, Potter County, Pennsylvania. Duplicates in collection of Academy of Natural Sciences.]

Sex.	Length.	Head.	Body.	Tail.	Vomerine teeth.	Spaces between toes.
Male	90	10.5	37.5	43	0	4
Do	94	10.5	36.5	48	0	4
Do	87	10	35	42	0	3½
Do	65	10	34	21	0	4
Female	87	9.5	33.5	44	3–3	4
Male	85	10	33	42	0	4
Do	81	10	33	38	0	4
Female	83	9	32	42	3–4	3½
Do	84	9	32	43	3–3	4
Do	87	9.5	32	44	3–3	4
Male	92	10	31	51	0	4
Female	73	9	31	33	4–5	4
Male	69	7.5	30.5	31	4–4	4
Female	75	8	30	37	3–3	4
Do	79	9	30	40	5–5	3½
Do	72	9	29	34	6–4	3
Male	71	9	29	31	2–1	4
Do	65	8.5	28.5	28	0	4
Female	61	8.5	27.5	26	3–3	3
Male	45	9.5	27	8.5	3–2	4
Female	68	7.5	26.5	34	4–4	4
Do	67	8	26	33	4–4	4
Do	68	9	26	33	4–4	.....
	42	6	19	17	.....	4
	35	5	15	15	.....	.....
	31	5	15	11	.....	3

DESMOGNATHUS OCHROPHAEA CAROLINENSIS DUNN.

Specimen.	Sex.	Length.	Head.	Body.	Tail.	Vomerine teeth.	Spaces between toes.	Locality.
U.S.N.M. 31150	Male	113	11	43	59	0	4	Mount Mitchell, N. C.
U.S.N.M. 31135[1]	do	102	11.5	40.5	50	0	4	Do.
E. R. D.	do	80	9	34	.....	0	4	Haywood County, N. C.
Do.	do	82	9.5	33.5	39	0	3	Do.
Do.	do	78	9	33	36	0	4½	Do.
U.S.N.M. 31136	Female	82	10	33	39	4–4	4	Mount Mitchell, N. C.
E. R. D.	Male	77	9.5	31.5	35	0	4	Haywood County, N. C.
Do.	Female	60	8	31	21	6–6	4	Do.
Do.	Male	67	10	31	26	0	4	Do.
Do.	do	76	11.5	29.5	35	0	4	Do.
Do.	do	57	8	28	21	0	4	Do.
Do.	Female	71	8.5	27.5	35	6–6	4	Do.
Do.	Male	72	9	27	36	4–4	4	Do.
Do.	do	58	7	26	25	4–2	4	Do.
Do.	do	66	8.5	25.5	32	0	4	Cane River, N. C.
Do.	do	64	8	24	32	4–4	4	Mount Mitchell, N. C.
U.S.N.M. 31137	do	65	8	24	32	4–4	3	Do.
E. R. D.	Female	65	8	23	34	3–3	4	Cane River, N. C.
U.S.N.M. 31133	.....	51	7	22	22	.....	.....	Mount Mitchell, N. C.
U.S.N.M. 31138	Female	59	7.5	21.5	29	6–6	4	Do.
U.S.N.M. 31134	.....	44	6	18	20	.....	.....	Do.

LEUROGNATHUS MARMORATA MOORE.

A. N. S. 4383	Male	128	17	58	53	0	3	Roan Mountain, N. C.
U. of Pa.	Female	120	15	54	51	0	2½	Blowing Rock, N. C.
Do.	do	117	15	.....	.....	0	2½	Grandfather Mountain, N. C.
Do.	do	108	14	41	31.5	0	2½	Do.
A. N. S.[1]	Male	98	13.5	46	41	0	2½	Do.
Am. Mus. 4519	Larva	63	8	25	30	.....	.....	Pineola, N. C.

[1] Type.

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DESCRIPTION OF A NEW SPECIES OF EXTINCT HORSE, EQUUS LAMBEI, FROM THE PLEISTOCENE OF YUKON TERRITORY.

By Oliver P. Hay,

Associate of the Carnegie Institution of Washington.

The writer has the privilege of describing what appears to be a new species of fossil horse from the Klondike region, Yukon Territory. The fine skull which forms the type of this species was found on April 10, 1903, by Mr. John M. Morrison, now of Anacortes, Washington, while mining for gold on Gold Run Creek. This is about 30 miles southeast of Dawson. He unearthed the skull himself on claim No. 34, at a depth of 32 feet below the surface. Mr. Morrison states that starting from the surface there was from 18 to 20 feet of muck; below this about 12 feet of fine gravel; and beneath this from 4 to 6 feet of coarse gravel, which carries gold. Immediately below this coarse gravel is the bedrock, and on this lay the skull. Mr. Morrison writes that in the eye sockets was "pay dirt" from which he panned gold. The deposit in which the skull was buried was frozen and may have been in this condition for thousands of years. To this new species is given the name *Equus lambei*, in honor of Mr. Lawrence M. Lambe, vertebrate palaeontologist of the Geological Survey of Canada.

Type-specimen.—Cat. No. 8226 U.S.N.M.

Type-locality.—Gold Run Creek, Klondike region, Yukon Territory.

Type-formation.—Pleistocene.

Diagnosis.—Belongs among the smaller and broad-skulled horses. Teeth unusually broad; their enamel little plicated; the protocones unusually long.

The skull is practically complete (pls. 56–58). What is unusual is that the skull and the lower jaw were together. The left third upper incisor and the left first lower incisor have been lost since exhumation. The extreme tips of the nasals are broken off, most of the vomer and the turbinal bones are gone, and a little bone here and there is missing. The skull is of the color of cream. Almost without other exception, bones from Alaska and Yukon are stained brown. The skull was that of a mare. Its age is believed to have been 12 years or more.

The following measurements have been obtained from the skull:

Measurements of the skull.

From middle of incisive border to front of foramen magnum (basilar length)	446
From middle of incisive border to front of posterior nares	245
From middle of incisive border to naso-premaxillary notch	167
From middle of incisive border to middle of occipital crest (vertex length)	498
From middle of incisive border to front of pm^3, direct	120
From middle of incisive border to front of orbit	302
From middle of incisive border to middle of line joining hinder borders of orbits (facial length)	343
From middle of incisive border to rear of orbit direct	357
From rear of orbit to middle of occipital crest	188
From occipital crest to middle of line joining rears of orbits (cranial length)	160
From rear of hard palate to notch in vomer	93
From notch in vomer to front of foramen magnum	116
Width across mastoid processes	102
Width across glenoid fossae	187
Width from outside to outside of parastyles of last molars	120
Width from outside to outside of last premolars	118
Width from outside to outside of outer incisors	72
Width of the face at the front of the orbits	152
Width at the rear of the orbits (frontal width)	198
Width on the maxillary ridges at maxillo-malar suture	171
Width of palate at last molars	65
Width of palate at pm^3, least	47
Width of palate at diastema, least	43
Length of orbit	54
From front of symphysis of lower jaw to rear of ascending ramus	385
Length of symphysis	80
Height of jaw of front of m_1	81
From front of symphysis to front of pm_2	108

In 1915 [1] the writer presented a table which gave various measurements and indices derived from the measurements of the skulls of 16 individuals of *Equus caballus*. The measurements were taken from a table prepared by Nehring.[2] Eight of these skulls were those of small horses, and the basilar lengths ranged from 426 mm. to 452 mm. In the other eight the basilar length varied from 536 mm. to 585 mm. By consulting the writer's table or that of Nehring it will be found that the short skulls are relatively broader than the larger ones, the cephalic index (= frontal width × 100 ÷ basilar length) varying from 42 to 45.9. The average is 44.2. In the long-headed horses the cephalic index varies from 38.9 to 43.6, the averages in the eight horses being 41.1. In the Yukon skull here described the cephalic index is 44.4, which shows that the species belonged among the small horses having broad skulls.

[1] Proc. U. S. Nat. Mus., vol. 48, p. 559.
[2] Landwirthsch. Jahrb., vol. 13, 1884, p. 81.

In Nehring's eight small horses the cranio-cephalic index (= cranial length × 100 ÷ basilar length) averaged 36; in the eight large horses it averaged only 33. In the Yukon skull it is 35.7.

In the eight small horses of the tables referred to the facio-cephalic index (facial length × 100 ÷ basilar length) average 76.1; in the large horses, 74.1 In *E. lambei* it is 76.9.

It is seen therefore that as compared with the races of *Equus caballus* the Yukon species, *E. lambei* ranges itself with the small horse having short and broad heads, but with a high facio-cephalic index.

It will be well to compare certain indices of the species here described with those of four other forms.

Table of indices.[1]

Species (types.)	Cephalic index.	Facio-cephalic index.	Cranio-cephalic index.	Index of tooth line.
Equus niobrarensis	45.2	75.3	34.3	33.7
E. niob. alaskae	44.2	73	35	34.1
E. hatcheri	42.8	74.8	35.3	33.9
E. laurentius	43	75	.....	33.3
E. lambei	44.4	76.9	35.9	37.4

It will be observed that the Yukon horse stands above the others of the table in the facio-cephalic and the cranio-cephalic indices and the index of the tooth line.

It is found that the brain case of the Yukon horse exceeds in size that of two skulls of the domestic horse at hand. In one of these, No. 843 of the United States National Museum, the width of the brain case is 21.1 per cent of the basilar length; the height above the lower surface of the cranial axis, 19.1 per cent. In the other, an old horse, No. 5044, the percentages are respectively 20.6 and 19.3. In the Yukon horse the percentages are both 23.1.

The lower jaw (pl. 56, fig. 1) differs greatly from that of an old domestic horse at hand. In the latter the angle of the jaw is very broad, and the width at the last premolar is only a little more than half that at the angle. In the Yukon horse the greatest width is 112 mm.; that at the last premolar, 84 mm.; just .75 of the width at the angle. This angle is very broad in *E. laurentius*.[2] The lower jaw of *E. niobrarensis*[3] and that of *E. hatcheri*[4] resemble considerably that of the species here described.

[1] These indices are taken partly from a table on page 590 of volume 44 of the Proceedings of the U. S. National Museum. Through an error the abbreviation *mm.* is found at the head of each of the columns of that table.

[2] Proc. U. S. Nat. Mus., vol. 44, 1913, p. 72.

[3] Idem, pl. 70.

[4] Proc. U. S. Nat. Mus., vol. 48, 1915, pl. 32.

Some minor features of the skull need to be mentioned. The interorbital region is flat, even a little concave. From the middle of the brain case the outline descends rather strongly to the occipital crest. The infraorbital foramen is situated unusually high. The space between the orbit and the foramen just named is swollen, being convex, not concave as it is in the domestic horse. The maxillary ridge is less prominent than in the domestic horse. The condylar foramen is in wide communication with the foramen lacerum posterius. The palate is more strongly vaulted than that of the domestic horse.

The teeth are in fine condition. They are, however, considerably worn, and to this perhaps is due to some extent, but not entirely, their unusual breadth and the great simplicity of the enamel. The premolars and molars appear to be worn down to about one-half of their original length. The last premolar has a height of 40 mm. The lower incisors are worn so that the cups have disappeared, but these are still present in all of the upper incisors. The following are the measurements:

Measurements of the upper teeth.

	mm.
Length of premolar-molar series	167
Length of premolar series	87
Length of molar series	77
Pm^3, length	36
width	28
protocone	12
Pm^3, length	25.5
width	28
protocone	17
Pm^4, length	26
width	29
protocone	17
M^1, length	22.5
width	27
protocone	14
M^2, length	24.4
width	27
protocone	16
M^3, length	27
width	24.5
protocone	19

Measurements of the lower teeth.

Length of premolar series	83
Length of molar series	80
Pm_2, length	31
width	17.5
Pm_3, length	26.5
width	19
Pm_4, length	26.5
width	18.8
M_1, length	22.5
width	16.5
M_2, length	26
width	16.5
M_3, length	32
width	16

The measurements of these teeth may be compared with those of *Equus hatcheri*, *E. niobrarensis*, *E. caballus*,[1] *E. francisci*,[2] *E. laurentius*[3] *E. complicatus*, *E. scotti*, *E. niobrarensis*, *E. laurentius*,[4] *E. niobrarensis alaskae*.[5]

The teeth are remarkable on account of their relatively large size and on account of the great breadth of the grinding surface as compared with its length. As shown in the table on page 437, the whole upper tooth line is equal to 37.4 per cent of the basilar length, while in the other species there considered, and in *E. caballus*, it lies between 33 per cent and about 34 per cent. The following tables show, in various species, the widths of the premolars and molars as compared with the length taken as 100:

Table of indices of crowns of upper teeth of extinct horses.

Teeth.	*E. lambei.*	*E. laurentius.*	*E. hatcheri.*	*E. niobrarensis.*	*E. niob. alaskae.*	*E. scotti.*
Pm^2	77.7	70.0	70.0	71.1	67.9	73.8
Pm^3	109.8	94.2	101.6	93.3	93.3	94.3
Pm^4	111.5	100.0	100.0	93.1	100.0	100.0
M^1	120.0	106.8	101.8	103.7	107.8	100.0
M^2	110.6	102.2	98.2	92.6	100.0	93.5
M^3	90.7	73.3	80.0	81.0	92.5	83.3

Table of indices of crowns of upper teeth of domestic horses.

Teeth.	No. 16274, A. M. N. H., 5 years.	No. 14131, A. M. N. H., 8 years.	No. 289, A. M. N. H., 15 years.	No. 16277, A. M. N. H., 20 years.	No. 843, U. S. N. M., 8 years.	No. 5044, U. S. N. M., 20 years.
Pm^2	67.5	69.9	59.7	66.7	71.1	66.6
Pm^3	89.1	96.2	93.2	101.9	93.3	105.5
Pm^4	91.7	96.4	98.2	108.0	93.1	103.7
M^1	90.0	103.9	108.3	116.2	103.7	120.9
M^2	88.3	101.9	102.8	116.3	92.6	111.0
M^3	74.1	74.6	75.0	75.0	81.0	82.2

From the table showing the relation of the width of the crowns to their lengths in the extinct species it is seen that the teeth of the Yukon horse are much broader. It is known, however, that as the upper teeth are worn down the fore-and-aft length of the crown diminishes more rapidly than the width, with the result that the index rises. The Yukon horse is older than any of the other extinct species used in comparison. In the next table the upper teeth of the Yukon horse are compared with those of domestic horses of various ages. The indices of the horses in the American Museum of Natural

[1] Proc. U. S. Nat. Museum, vol. 48, 1915, p. 531.
[2] Idem, p. 539.
[3] Idem, vol. 44, 1913, p. 584.
[4] Iowa Geol Surv., vol. 23, pp. 160–208.
[5] Smiths. Misc. Coll., vol. 61, No. 2, p. 1.

History are derived from measurements furnished by Gidley.[1] Not even in the horse supposed to be 20 years old are the teeth as broad relatively to the length as in the Yukon fossil. However, in a horse in the U. S. National Museum (No. 5044), the first and second molars exceed very slightly in relative breadth those of the Yukon horse; but that horse is evidently much older; or, at least, the teeth are much more worn. The cups are gone from the upper incisors and the last premolar is worn down to a height of only 26 mm.

When we come to compare the lower teeth with those of the several extinct species, with those of a large horse about 8 years old, and with the old horse just mentioned, it is found that none of them approach in width the teeth of the Yukon horse.

Table of indices of crowns of lower teeth of horses.

Teeth.	*E. lambei.*	*E. laurentius.*	*E. hatcheri.*	*E. niobrarensis.*	*E. scotti.*	*E. caballus* No. 174960.	*E. caballus* No. 5044.
Pm_2	53.2	46.9	40.0	42.8	48.6	43.1	46.9
Pm_3	71.7	58.9	60.0	57.1	53.0	60.0	60.4
Pm_4	70.9	55.2	56.7	53.3	54.5	58.3	61.3
M_1	75.6	60.0	62.1	50.9	57.6	55.7	60.9
M_2	65.4	53.9	56.1	50.0	48.4	54.6	61.5
M_3	48.4	46.7	42.8	43.3	44.1	40.6	42.2

The grinding faces of the upper teeth (pl. 57) present various peculiarities. The outer styles are only moderately developed. As compared with the domestic horse, the outer face of the paracone is shallow and flat. The fossettes are extremely narrow. This is not due wholly to age, for those of older horses are wider. As a result of this narrowness the areas representing the other elements of the teeth are broader than usual. The protocones are unusually long and they are thin from side to side. Their lengths are given among the measurements of the upper teeth. In some cases the anterior end comes into contact with the enamel of the next tooth in front. The post-protoconal valley is directed strongly forward; and it lacks much of attaining the center of the crown. In each premolar there is an indication of a reentrant fold near the head of the valley, but none in the molars. Probably at an earlier stage of wear this fold was deeper, but in the premolars of a much older domestic horse the valley has the fold very distinct.

The enamel surrounding the fossettes is extremely simple (pl. 57, figs. 2, 3); but here again it is necessary to make some, but not too much, allowance for age. Even the very old domestic horse referred to has the enamel more plicated.

As shown in a table given above, the lower teeth (pl. 58, fig. 2) likewise are unusually broad. The outer valley does not in any of

[1] Bull. Amer. Mus. Nat. Hist., vol. 14, p. 98.

the teeth push itself in between the longitudinally directed portions of the valleys entering from the inner side of the tooth. On the inner side of the tooth the groove between the metaconid and the metastylid is very deep and it is angular at its inner end. The longitudinal expansion of the hinder of the two inner valleys of the molars and last premolar is directed obliquely to the long axis of the tooth.

In the same mining claim, and apparently at the same depth, Mr. Morrison found the right ramus of the lower jaw of another horse. The ascending portion is missing. All the cheek teeth are present, a large canine, and five of the incisors. The teeth show that the animal was a male about 5 years old. The catalogue number in the U. S. National Museum is 8427.

That portion of the jaw which is preserved resembles considerably that of *E. lambei* in form and dimensions. It differs from the latter and from all other equine jaws examined in having on the outer face a strongly developed ridge, which, beginning at pm_2, runs downward and backward, reaching the lower border below the penultimate molar. The thickness of the jaw at the last premolar is 34 mm.

The length of the premolar-molar series is 172 mm.; of the premolar series, 90 mm.; of the molar series, 83 mm.

Measurements of lower teeth in millimeters.

Teeth.	Height.	Length.	Width.	Index.
Pm_2	.....	35.0	16.2	46.3
Pm_3	60	27.8	17.8	64.0
Pm_4	75	28.2	19.5	69.2
M_1	60	26.5	17.0	64.2
M_2	69	26.0	16.0	61.5
M_3	69	30.0	16.0	53.3

A comparison of these measurements and indices with those obtained from the lower jaw of the type of *E. lambei* shows that the two sets of teeth agree in many respects. The differences might be attributed to different stages of wear. It is not, however, certain that the relations of length and width vary greatly with the stages of wear in the lower teeth.

When the structure of the teeth of the jaws of the two horses is compared there appear various differences which seem to be important. The groove between the metaconid and the metastylid is not so deep and angular in the odd jaw as it is in the type of *E. lambei*. In the third and fourth premolars of the odd jaw the longitudinal portions of the anterior valley is broader and has a shallow infolding of the enamel which does not appear in the other jaw. In the molars the longitudinal portion of the hinder valley is not

obliquely directed forward and outward, as in *E. lambei*, but has its anterior end turned inward so strongly that the metastylid is nearly cut off from the metaconid. The hinder end of the loop is likewise turned more or less outward.

The outer incisor tooth of the jaw here described appears to have been quite different from that of the type of *E. lambei*. Although this incisor in the type is worn until the bottom of the cup has passed, there are yet indications of its former presence. In this incisor of the odd jaw the cup is replaced by a broad groove on the hinder face of the crown.

It is believed that this odd jaw belongs to a species distinct from the type *E. lambei*, but it is perhaps better to await further discoveries before giving it a name.

In any studies of the animals found in Alaska and Yukon it is important that we consider carefully the related species which are found in northeastern Asia.

In 1893[1] J. Tscherski described a well-preserved skull of a horse which had been obtained at Liakhof Island, in the Arctic Ocean. This skull he referred to *Equus caballus*. Many measurements taken from this skull are given on pages 333 and 334 of Tscherski's paper. The basilar length was 502 mm.; the facial width, 216 mm.; the distance from the rear of the orbit to the incisive border, 381.5 mm.; the width of the face at the maxillo-malar suture (width of cheeks), 191 mm.; the length of the upper tooth line, 175 mm.

The cephalic index of this skull is therefore 43. The facial length may be estimated from the right angled triangle formed by the half of the frontal width and the distance from the incisive border to the rear of the orbit. It is 365.8 mm. The facio-cephalic index is therefore 72.6. On account of injury done to the occipital crest the vertex length and the cranial length could not be obtained. Hence the cranio-cephalic index can not be determined. The index of the tooth line (molar-premolar length $\times$ 100 $\div$ basilar length) is 34.9. If these fundamental measurements and the indices of this Siberian skull and that from Yukon are brought together they may be easily compared.

Table of measurements and indices.

Horse.	Basilar length.	Frontal width.	Cephalic index.	Facial length.	Facio-cephalic index.	Tooth line.	Tooth index.
Yukon	446	198	44.4	343	76.9	167	35.2
Siberian	502	216	43	365.8	72.7	175	34.9

[1] Mem. Acad. Sci. St. Petersb., vol. 40, p. 335, pl. 5; pl. 6, fig. 5.

It will be seen that the Yukon horse is quite distinct from the one described by Tscherski. It is smaller, and had a head somewhat broader relatively to the length, and a considerably longer face. The teeth of the Siberian horse are relatively broad and the protocone approaches in width that of *E. lambei;* but in many important features the teeth are quite different.

A careful examination of Tscherski's figure 4 of his plate 5 shows that the part of the maxilla behind the infraorbital foramen in the Siberian horse was not swollen as it is in the Yukon species; but was, rather, considerably excavated.

EXPLANATION OF PLATES.

PLATE 56.
Equus lambei. Type.

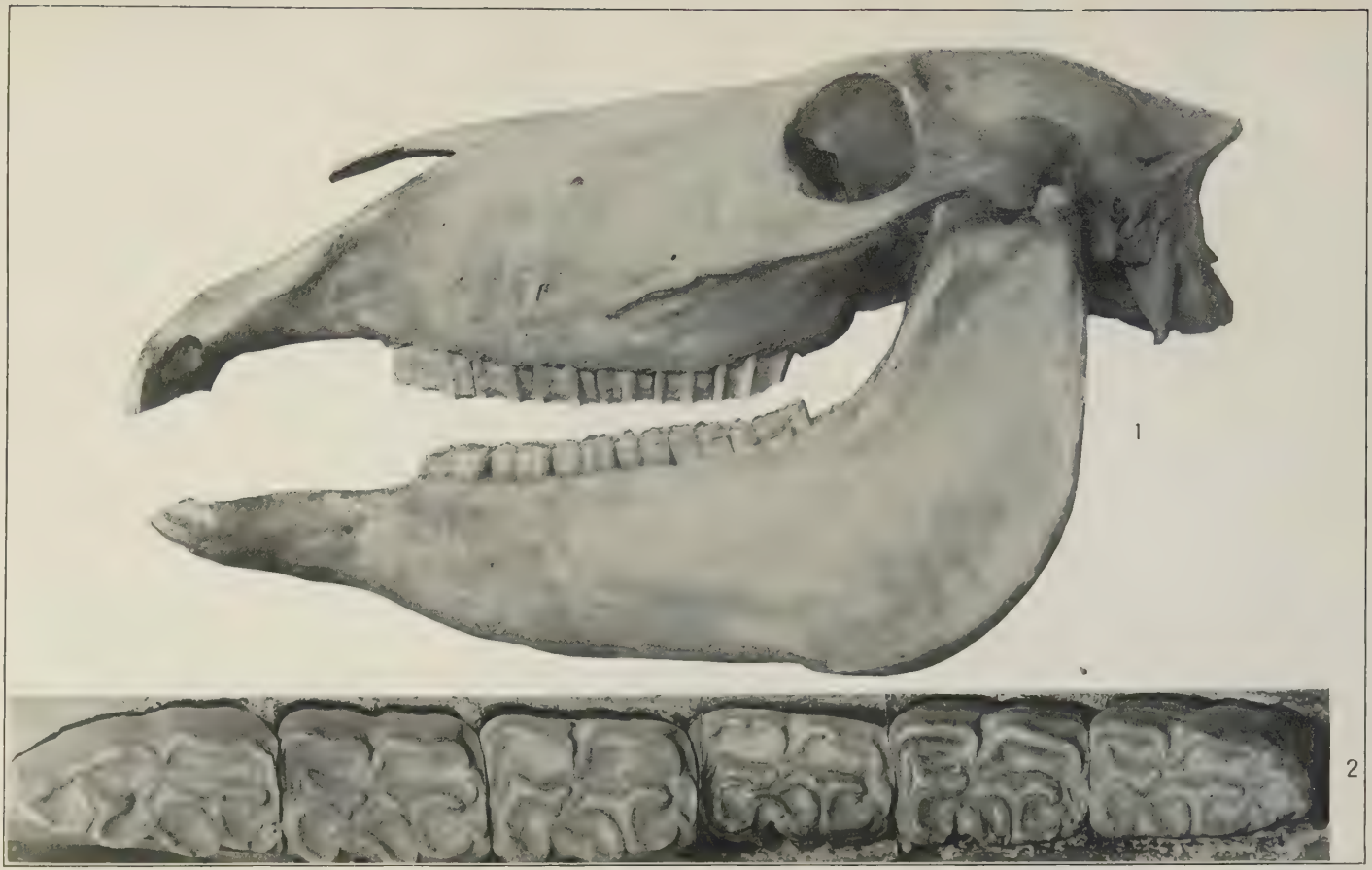
FIG. 1. View of left side of skull. × .318.
2. View of lower premolars and molars. × 1.

PLATE 57.
Equus lambei. Type.

FIG. 1. View of lower surface of skull. × .33.
2. View of grinding faces of premolars. × 1.
3. View of grinding faces of molars. × 1.

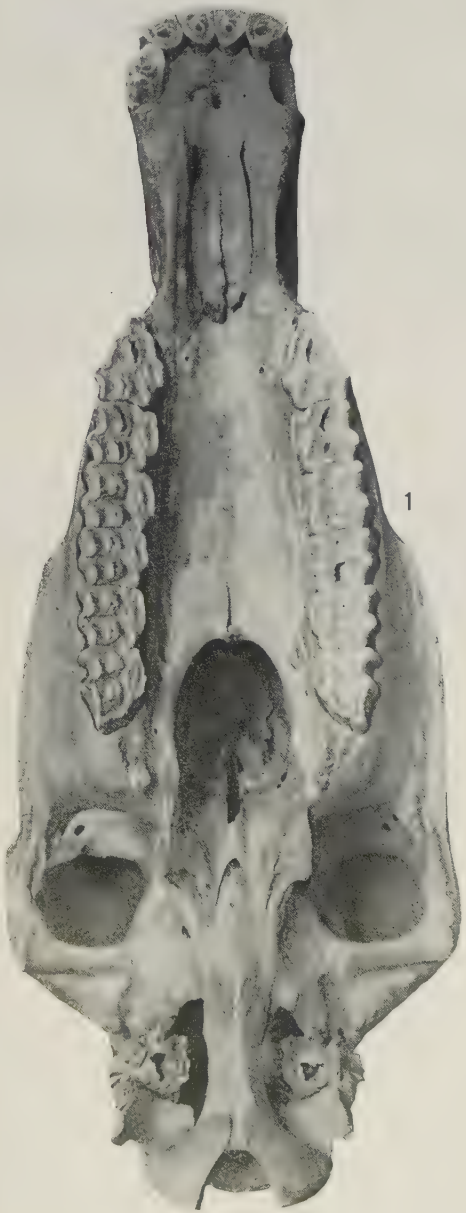
PLATE 58.
Equus lambei. Type.

FIG. 1. View of upper surface of skull. × ½.
2. View of grinding faces of lower premolars and molars. × 1.



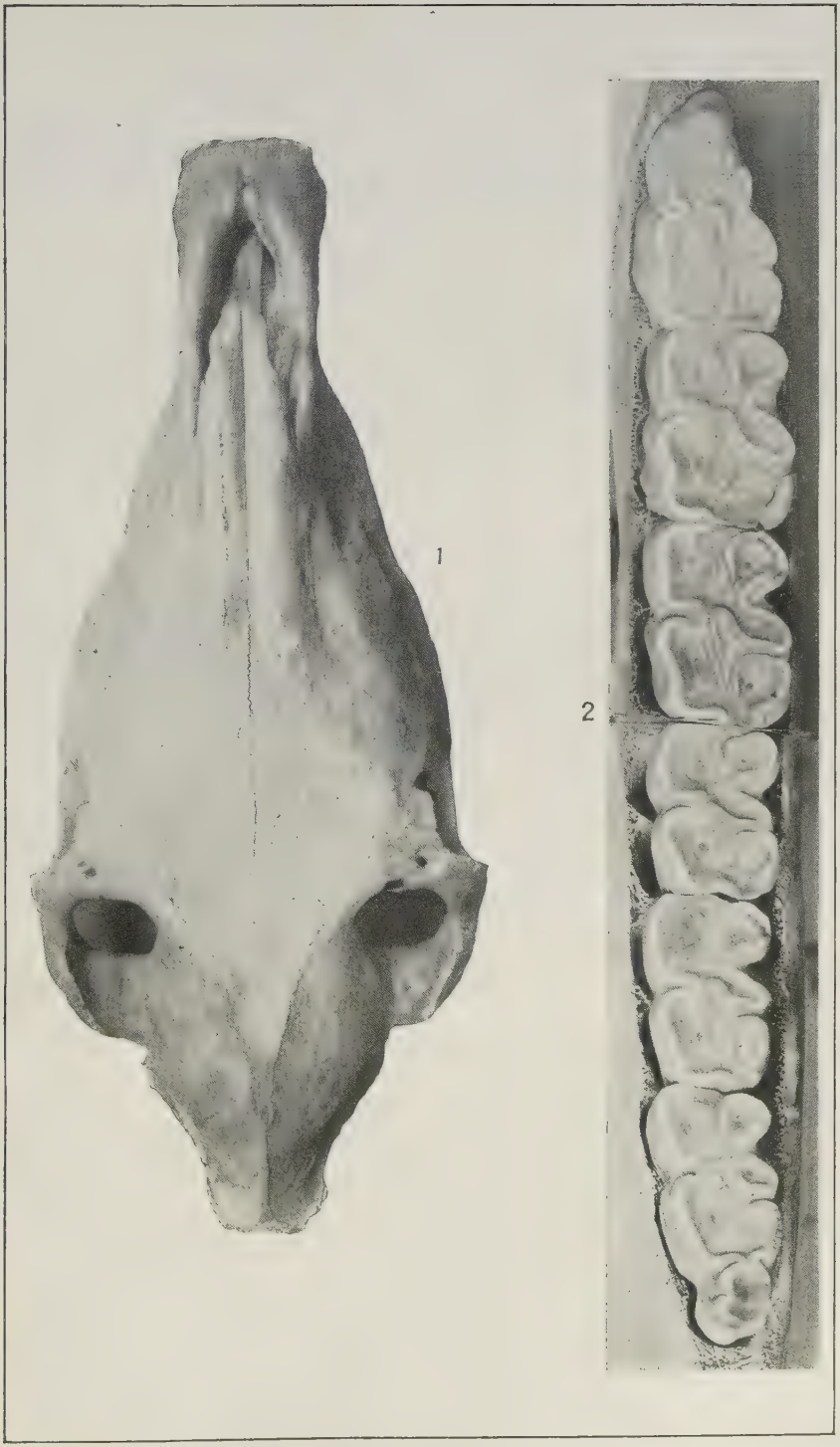
SKULL AND LOWER TEETH OF EQUUS LAMBEI.

FOR EXPLANATION OF PLATE SEE PAGE 443.



SKULL AND TEETH OF EQUUS LAMBEI.

FOR EXPLANATION OF PLATE SEE PAGE 443.



SKULL AND TEETH OF EQUUS LAMBEI.

FOR EXPLANATION OF PLATE SEE PAGE 443.

NOTES AND DESCRIPTIONS OF MISCELLANEOUS CHALCID-FLIES (HYMENOPTERA).

By A. A. Girault,
Of the Bureau of Entomology, United States Department of Agriculture.

The types of all the new forms described beneath have been deposited in the United States National Museum.

TUMIDISCAPUS OOPHAGUS, new species.

Female.—Length, 0.75 mm., excluding the ovipositor, which is extruded for a length equal to about half that of the abdomen. Scutum and scutellum with a narrow median sulcus.

Dull honey yellow, the wings a little yellowish under and across from the marginal vein, the abdomen black except the disk; ovipositor valves black. Body very finely scaly. Antennae dusky; pedicel twice longer than wide at apex, a little shorter than club 1; funicles 1–2 a little unequal, 2 quadrate, 1 a little shorter, 2 distinctly less than half the length of club 1, the latter two-thirds the length of the second club joint which is about thrice longer than wide. Fore wings finely ciliate, the six lines proximad of the hairless line of a size about three times that of the main ciliation. Middle tibial spur long, moderately slender. Antennae inserted at the mouth border. Mandibles tridentate. Hind wings with about nine lines of fine discal ciliation where widest. Scape slender.

The male is smaller and differs principally in having the pedicel shorter, the two funicle joints wider than long, the two club joints subequal, each over twice the length of the pedicel, which is much longer than the funicle. Male scape much dilated.

From many specimen of both sexes reared from eggs of *Oxya velox*, Coimbatore, Southern India, December 3, 1915 (Y. R. Row).

Types.—Cat. No. 20734, U.S.N.M., many females and a few males on two tags and a slide.

ABBELLA AMERICANA, new species.

Female.—Similar to *acuminata*, but the abdomen bears five complete cross stripes, of which the first two near the base are very narrow, the third and fourth are broadest, the third a little distad of middle;

5 just before apex. Also the substigmal spot is faintly complete, some of the lines of discal cilia regular and there is a short (but 2–3 setae) line of cilia leading back from the stigmal vein. Hind wings with only two lines of discal cilia, these cephalad. The male is similar, but the abdomen is more blunt at apex.

Many specimens reared from jassid eggs in *Elymus*, Salt Lake City, Utah, August 1911 (C. N. Ainslie).

Types.—Cat. No. 20727, U.S.N.M., two males, four females on a slide (with specimens of an *Oligosita*).

GONATOCERUS UTAHENSIS, new species.

Female.—Runs to *koebelei* Perkins, but the forewings are uniformly infuscated except out from base widely (distal half or more), the coxae are black broadly at base, the scape so above and below, the pedicel is pale while funicle 2 is longest, somewhat longer than the pedicel, 3 slightly shorter, 1 equal to 4, 5, 7, or 8; 6 shortest, subglobular, half the length of 2.

Four females with the *Abbella*.

Types.—Cat. No. 20728, U.S.N.M., the specimens on two slides.

CIRROSPILUS OCELLATUS, new species.

Female.—Similar in stature to *flavicinctus*. Dark metallic green, the wings hyaline, the legs lemon yellow except the coxae, hind femur, and distal tarsal joint. Lateral margin of vertex against the eye broadly bright yellow, the coloring extending along the eye margin narrowly to the face and occiput; a triangle in middle of upper face, base against the vertex and a broad oblique mark nearly to apex of the head from each antennal fossa, pale yellow. Apex of hind femur yellow, also of pedicel beneath. Funicle 2 quadrate, a half shorter than 1, which is a little longer than the pedicel. Mandibles 5-dentate. Club with a terminal spine, its joints wider than long, the region as long as the funicle or longer. Thorax and abdomen scaly, the propodeum with a narrow median carina and no others, subglabrous, its very short neck also carinated.

One female, Algonquin, Illinois (W. A. Nason).

Type.—Cat. No. 20696, U.S.N.M., the female on a tag, the head and a hind leg on a slide.

Eulophus pictus Nees is a *Pseudiglyphomyia*, which is thus probably a synonym of *Cirrospilus*. This specimen, which is in the United States National Museum, however, does not agree with Nees' description.

EULOPHUS CALIFORNICUS, new species.

Female.—Length, 1 mm. Dark metallic purple, the tips of tibiae and the tarsi brown, the hind tibiae brown except for a broad cinctus between apex and middle. Forewings with a broad smoky band across

them from the whole of the marginal vein. Funicle 1 slender, twice longer than wide, a little longer than the pedicel; 2 and 3 quadrate, a little longer than any club joint; second ring-joint large, distinct, the first very thin; club with a short terminal nipple. Head, abdomen, and thorax finely scaly, the scutellum with the scaliness lined longitudinally. Parapsidal furrows a third complete. Axillae advanced. Propodeum with a delicate median carina and no others nor sulci, the spiracle minute, round, over its own diameter from cephalic margin. Abdomen with a very transverse petiole, depressed, wider than the thorax and a little longer. Stigmal and postmarginal veins subequal, long, half the length of the marginal, the latter shorter than the submarginal. (One wing with thickened venation.) Mandibles, 5-dentate.

A female in the United States National Museum from Los Angeles County, California, April 5, 1886 (Coquillett).

Type.—Cat. No. 20733, U.S.N.M., the female minutien-mounted, the head, wings, and hind legs on a slide.

CHRYSOPOPHAGUS KANSENSIS, new species.

Female.—Similar to *banksi* Howard, but differs in not having the legs uniformly concolorous, the hind tibiae being purple except at base, the hind femora purplish above, while the first and last pairs of coxae are silvery white. Moreover, the forewings are much more deeply infuscated (from base of marginal vein nearly to apex). From *amplicornis* Gahan in not having the abdomen purplish distad, its greater size, longer pedicel, and funicle 1.

One female on a slide, Manhattan, Kansas (C. N. Ainslie).

Type.—Cat. No. 20736, U.S.N.M., the above specimen.

APHELINOIDEA PLUTELLA Girault.

One female, swept from green oats, July 14, 1909, Cimarron, New Mexico (C. N. Ainslie).

TRICHOGRAMMA RETORRIDUM Girault.

A female, Springer, New Mexico, September 16, 1909, from eggs in *Elymus canadensis* (C. N. Ainslie).

SYMPIESIS SUBSTIGMATUS, new species.

Female.—Similar to *stigmatus* but differing in that the abdomen is not longer than usual, the base above is as broadly metallic as the apex (venter entirely yellowish except distal fourth), and the median stripe of the abdomen sends off two faint cross-stripes from nodular swellings, the two stripes dividing the orange space equally, or nearly, into three areas; also the substigmal spot is faint, not jet, the scape is not wholly metallic but white along its ventral edge; the lateral margins of the abdomen are not metallic and there is no lateral carina

on the propodeum. Mandibles 6-dentate. Propodeum as in *Notanisomorpha*.

One female, United States, June 24, 1883.

Type.—Cat. No. 20745, U.S.N.M., the female on a tag, a hind tibia, the head and forewing on slide.

THRIPOCTENUS AMERICENSIS, new species.

Female.—Length, 0.75 mm. Club ovate, enlarged, distinctly 2-jointed and with a terminal spine; it resembles the club of the trichogrammatid genus *Tumidiclava*. Black, the wings subhyaline; a little less than the proximal half of the abdomen orange yellow; legs except coxae (rarely the femora at base) and the antennae pale, more or less suffused with dusky. Scape slender; pedicel two-thirds longer than wide at apex, longer than funicle 2; funicle joints narrower at base, 1 subquadrate, 2 twice the size of 1, a little longer than wide. Club longer than the funicle and much wider, divided a little before the middle; one minute ring-joint. Longest marginal cilia of the forewing a fourth the greatest wing width; hind wing nearly as wide across apex of venation as their caudal marginal fringes are long, ciliate discally. Abdomen subpetiolate, the ovipositor free, inserted at middle, their valves tipping apex. Scutellum rounded. Body scaly. Mandibles apparently absent or else very pale and edentate. Propodeum plane, the spiracle small, round.

From many females on a slide, Salt Lake City, Utah, swept from alfalfa July 12, 1912 (C. N. Ainslie).

Types.—Cat. No. 20729, U.S.N.M., the above females.

As in the genotype of *Paromphale*, one female bore in one antenna but a single funicle joint which from its length was obviously made up of the two united. This species differs from the description of *Paromphale* in lacking one ring-joint and dentate mandibles; moreover, the antennae are clothed but sparsely with very minute setae, not long hairs. Otherwise, it agrees with that description. The genus is unstable, the antennae apparently now undergoing reduction. The two funicle and club joints and the long postmarginal vein characterize it. It is an Omphaline.

CHEILONEURUS DACTYLOPII Howard.

This is a species of *Achrysopophagus* Girault.

CHEILONEURUS AMPLICORNIS Gahan.

This is a *Chrysopophagus*, as is also *lineatiscapus* Gahan, though in the latter the head is shorter from cephalic aspect.

SYMPIESIS ANCYLAE, new species.

Female.—Similar to *guttatipennis*, but the forewing is more or less stained (quite a large cloud, faint) under the apex of the submarginal vein, the tibiae and knees are brownish, the abdomen is reddish yel-

low except across base and apex rather narrowly (apex more broadly), the lateral margins very narrowly and a broad median stripe, which is conical from apex and does not quite reach base and whose margins are wavy; otherwise the same but there is a delicate median carina on the propodeum (absent in the other). Mandibles 6-dentate.

Two females reared from *Ancylis*, new species, Whitesboro, New Jersey, July 20, 1916 (H. B. Scammell).

Types.—Cat. No. 20746, U.S.N.M., the females on tags, a head and forewing on a slide.

ASTICHUS BIMACULATIPENNIS Girault.

Belongs to *Sympiesis* and is very close to *bimaculatus* Crawford. It differs in having the scape, cephalic tibiae, and distal halves of the other tibiae dark reddish instead of white, and the distal spot on the forewing (the substigmal) is blacker and twice larger; moreover, there is but one lateral carina on the propodeum. The antenna in *bimaculatipennis* as in the other species. Mandibles 6-dentate. Type examined (by courtesy of Dr. S. A. Forbes).

TRYDYMUS AUREIPES, new species.

Female.—Length, 1.80 mm.

Resembles *poloni*, but the abdomen is not longer than the thorax, the legs are entirely golden yellow; the clypeus is similarly produced, but also has a slight, shallow median concavity; the antennae are all yellow except the pedicel above (except at apex) and the dorsal aspect of the first two or three funicle joints (darkened); the cheeks are a half shorter (not a fifth the length of the eyes), the antennae are a little above the ventral ends of the eyes, the meson of the propodeum is longitudinally rugulose, the cephalic foveae therefore absent or obliterated, the spiracle oblong and cephalad.

Described from two females, Jacksonville, Florida (Ashmead).

Types.—Cat. No. 20421, U.S.N.M., the specimens on two tags with the types of the next species, a forewing on a slide with the same of the next species, and a head and the caudal legs of the next species.

TRYDYMUS BIGUTTATIPENNIS, new species.

Female.—In habitus very similar to the preceding, but the cheeks are of normal length (half or more of the length of the eyes, the antennae a little below the middle of the face), the postmarginal vein is only slightly longer than the stigmal, in the forewing there is distinct fuscous stain surrounding the whole stigmal vein; an obscure stain (larger) at disto-caudal margin, and a second distinct one (longer than wide) from the base of the marginal vein (the latter over

twice the length of the stigmal); funicle 5 is a little longer than wide, a half longer than wide, and the distal half of the caudal tibia is submetallic. Spiracle round, at cephalic margin.

From two females mounted with *aureipes*.

Types.—Cat. No. 20422, U.S.N.M., two females on tags and a slide as noted above.

TRYDYMUS APHIDIS, new species.

Female.—Like *robiniaecola* Ashmead, but the propodeum is shorter, and subglabrous, the caudal tibiae have the distal half white (not the tip only), bearing a rather narrow cinctus near middle, the abdomen slender and cylindrical while the male has the legs all pale except the coxae (colored like the female in the other species, except the tibiae). Mandibles 4-dentate. Propodeum with an oblique, longer than wide fovea at apex (caudad) near the meson.

From one male, three females reared from *Lasioptera vitis*, July 1887, New York (Lintner).

Types.—Cat. No. 20420, U.S.N.M., a pair on tags, a female head and caudal legs on a slide.

DESCRIPTION OF A NEW SPECIES OF CRAB FROM THE CALIFORNIA PLIOCENE.

By Mary J. Rathbun,
Associate in Zoology, United States National Museum.

The specimen here described was given to the United States National Museum by Mr. J. Z. Gilbert, of Los Angeles, California, who obtained it from the foundation of one of the large buildings in that city. Mr. Gilbert states that it was associated with a large number of marine shells embedded in blue clay; that it is the same formation as outcrops on the south side of the Hill Street hills at Fourth Street and Broadway; and that the formation lies unconformably under the fresh-water gravel, sand, and bowlders, and at an angle of about 35°.

CANCER URBANUS, new species.

Plate 59.

Type-locality.—Los Angeles, California; from foundation of large building; Pliocene period; J. Z. Gilbert, collector and donor; 1914.

Holotype.—Cat. No. 324300, U.S.N.M. A single specimen embedded in blue clay. Only the carapace remains and that is imperfect, especially as to the margins. Carapace narrow, actual width 44 mm., measured between antero-lateral sinuses; estimated width at the same place, 48 mm.; length, about 34 mm. There are two diagonal breaks on the left side of the carapace with corresponding faults; the width of the right half is therefore more nearly normal. The surface is about equally convex from side to side and from front to back. The interregional depressions are deep; surface uneven, closely granulate, the granules larger and more prominent on the most elevated portions. (See pl. 59.) Antero-lateral teeth 9, including the tooth at the lateral angle of the carapace and at the outer angle of the orbit; teeth acute, their margins straight, anterior margin usually considerably shorter than posterior margin; margins of seventh or widest tooth nearly equal. Edge of front and orbit broken away, but the furrows which lead back from the sinuses of the anterior margin are deep.

Posterior and postero-lateral margins granulate; it is impossible to tell if there is a postero-lateral tooth or spine.

Of the species now inhabiting the California coast, this species resembles most *C. antennarius* Stimpson.[1] This last has also an uneven surface, with longitudinal furrows and thickened teeth alternating along the anterior margin; its granulation is much more even than in the fossil form, and the antero-lateral teeth longer and more curved.

[1] Proc. California Acad. Sci., vol. 1, 1856 ,p. 88.

A NEW FOSSIL CRAB FROM THE CALIFORNIA PLIOCENE.

FOR DESCRIPTION OF SPECIMEN SEE PAGE 451.

FOSSIL REMAINS OF WHAT APPEARS TO BE A PASSERINE BIRD FROM THE FLORISSANT SHALES OF COLORADO.

By R. W. Shufeldt,
Of Washington, District of Columbia.

The specimen here to be described was collected by its present owner, Prof. Ira E. Cutler, of the University of Denver, Denver, Colorado, and forwarded to the United States National Museum for description. [My attention was called to it by Mr. Charles W. Gilmore, of the National Museum, at whose request the following description has been made:]

According to Professor Cutler the specimen was found early in August, 1915, in a gutter beside the road leading out of the town of Florissant, Colorado, in a locality where no specimens have heretofore been discovered. It was fully half a mile from the much-worked beds, from which so many fossils have been taken for a number of years past.

It would seem that Professor Cutler retained the bones of this fossil bird, and what I have before me at this writing are simply impressions of them; that is, the portion of the matrix or slab lifted off of such parts of the skeleton as were discovered. Fortunately, these impressions are tolerably sharp, but they are by no means as accurate for scientific description as the bones themselves. No other parts of the skeleton were found, however, after a rather long and careful search. I have made a negative of this specimen which shows it natural size, and a reproduction of a print from this is given in Plate 60, while in the reproduction of a second print, Plate 61, the bones of the lower extremity have been outlined by me carefully in ink, in order to show their size and the positions they severally occupy in the matrix. On the side of the slab where the impressions are the surface is smooth, while upon the other side it is overlaid with a finely granulated and extremely thin concretion. (Here may be noted the number of the specimen, namely 8541, U.S.N.M.). This piece of shale, as is shown in the plates, is in three pieces, and each averages about a millimeter and a half in thickness. The upper and largest piece (1) presents upon its surface the impression of the bones of a part of the lower extremity of an average-sized bird;

this, by the toes, is extended onto the smallest piece of the slab (2); while on the remaining piece (3) there is the impression of the hinder two-thirds of the pelvis, five (5) coccygeal vertebrae, and the upper portion of the left femur. No other bones are anywhere visible.

So far as these impressions seem to indicate they are of bones that may easily have belonged to some passerine bird of medium proportions. I have made comparisons with several skeletons of *Passeres* belonging to the collections of the United States National Museum; and, taking everything into consideration, in so far as the common American representatives of that group are concerned, I find it comes as near a bird of the size of the Purple Grackle (*Quiscalus purpureus*) as any other. So little of this fossil, however, has been thus far discovered that it should occasion no surprise to find that these bones belonged to some other species of an entirely different group, not passerine at all.

The skeleton of the Purple Grackle with which I have compared it is No. 16708, from an individual collected on April 29, 1883, by Mr. L. M. McCormick. In slab 1 of the plates, *a* invites attention to the impressions of the lower end of a tibiotarsus, bearing its normal relations to the tarso-metatarsus (*b*) of the same limb. As *a* is imperfect, nothing would be conveyed by giving its length; *b* has a length of 3.1 cms., the corresponding bone in *Quiscalus purpureus* having a length of 3.9 cms. It will be noted that *c* is but faintly impressed upon the slab, and I take it to be the other tibiotarsus, the distal extremity of which is missing. This bone in *Quiscalus* has a length of 5.5 cms., and the imperfect part of the specimen on the slab measures 4.6 cms. in length. *d* invites attention to the impressions of the toes, in which the proximal joint of hallux measures considerably less than in *Quiscalus purpureus*, the latter having a length of 1.4 cms., and in the fossil but 9 mm. (approx.).

Passing to the remaining portion of this slab (3) it is to be noted that the impression of the *femur*, which occupies about its normal position in the skeleton, is of exactly the same size as we find it to be in the Grackle with which I am comparing it. It does not admit, however, of obtaining its length, as only the impression of the upper portion is to be found on the slab. The impressions of the *five coccygeal vertebrae* are in all respects just what we would find were they made by those of the Grackle. The *pygostyle* is off the slab. Such parts as are shown on the slab of the impression of the *pelvis* (3) I have measured and compared with the corresponding parts in the Grackle's skeleton, and, in measurements at least, they are practically in agreement.

It is quite possible that the bones that made these impressions were those of a passerine bird about the size of the Purple Grackle, but they are of such a nature, with respect to perfectness, number,

and kind, that there is no certainty about it whatever. On the other hand, if passerine, they surely do not represent *Quiscalus purpureus*, but only a form about its size, and there is a long list of them.

My impression is that the specimen is of a passerine bird, one with a short hallux and rather short tarso-metatarsus, but that is as far as we should go until more material representing the same species comes to light.

PLATE 60.

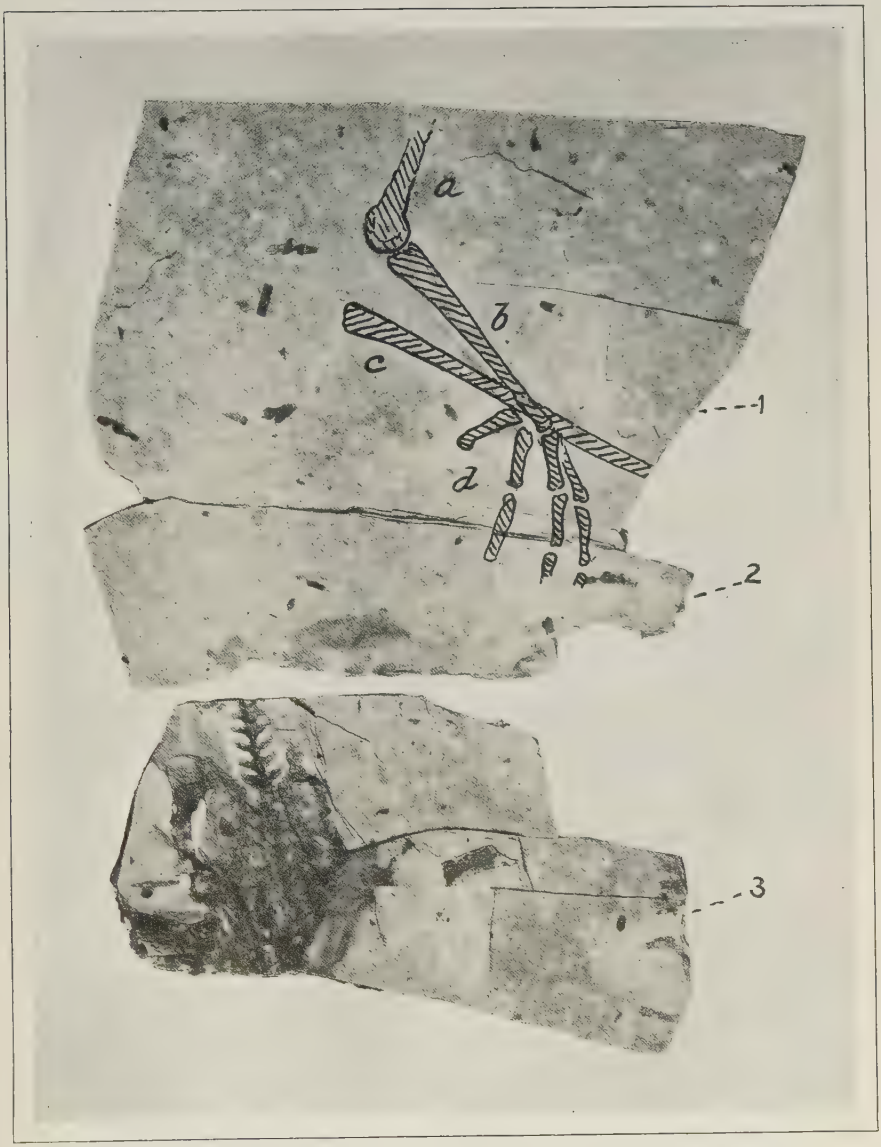
The slab containing the impressions of the bones of the pelvic extremities, 1 and 2; and 3 those of a part of the pelvis and upper portion of the left femur. All natural size. Reproduced from the author's photograph.

PLATE 61.

The same, with *a*, *b*, *c*, and *d*, giving the limb bones as outlined in ink, to better present their number, positions, and proportions.

IMPRESSION OF FOSSIL BIRD FROM COLORADO.

FOR EXPLANATION OF PLATE SEE PAGE 455.



IMPRESSION OF FOSSIL BIRD FROM COLORADO, WITH BONES OF LOWER LIMB OUTLINED IN INK.

FOR DESCRIPTION SPECIMEN SEE PAGE 455.

EIGHT NEW SPECIES OF REARED ICHNEUMON-FLIES, WITH NOTES ON SOME OTHER SPECIES.

By R. A. Cushman,

Of the Bureau of Entomology, United States Department of Agriculture.

The eight new species herein described were all reared by agents of the Bureau of Entomology, and the majority of them are represented by considerable series. The notes on previously described species are included in the hope that they will add something to the definition of the species. They are based on newly reared material.

Genus MICROCRYPTUS Thomson.

(CRYPTUS) MICROCRYPTUS OSCULATUS (Provancher).

A considerable series of what appears to be this species has been reared as a primary parasite from larvae of *Ametastegia glabrata* (Fallen) by Mr. E. J. Newcomer at Wenatchee, Washington. It is extemely variable in respect to the presence and extent of the white color of the face. One male is very like a male compared with the type by Mr. S. A. Rohwer and said by him to differ from the type only in being somewhat smaller and having on the face a white instead of a piceous spot. In these two specimens the mandibles, palpi, clypeus, a facial spot, and the tegulae are white or whitish. Among the other males, of which there are nine, is exhibited variation in both directions. In the darkest form only the mandibles, clypeus, and tegulae are white. In those of the other extreme the white embraces the palpi, mandibles, the whole face below the antennae, the cheeks, a spot on the lower side of the scape, the front and middle coxae and trochanters, the tegulae, and a small humeral spot, and the front edge of the pronotum shows a tendency toward this color. In the females only the palpi, mandibles, tegulae, and an incomplete antennal annulus embracing more or less of two segments display the white color, and at the dark end of the series it is replaced even there by black or piceous. In all specimens the wing bases are white.

The females are from 6.5 to 8.5 mm. long and the males 5.5 to 8.5 mm. The ovipositor varies slightly in length, averaging somewhat more than half as long as the abdomen.

Very few of the specimens exhibit the infuscation at the apex of the hind femur, and marked variation occurs in the form of the propodeal areas and the strength of the carinae.

Genus BATHYTHRIX Foerster (Howard).

Only two North American species have been referred to this genus. These are *B. meteori* Howard, the genotype, and *B. pimplae* Howard. It is worthy of note that both of these species have the clypeus apically with two nipple-like teeth. In the genotype these structures are widely separated and the clypeus between is deeply impressed, while in *pimplae* they are close together and the clypeus is not impressed. In the Japanese *B. kuwanae* Viereck, which is apparently properly placed in this genus, the clypeus lacks both teeth and impression. The new species described below has the teeth, but lacks the impression. In the new species the clypeal vestiture is less conspicuous than indicated in Foerster's characterization of the genus, and this character must be considered of doubtful generic value.

Key to North American Species.

General color blackish and rufous; tergites 2 to 4 longitudinally aciculate at base; clypeus impressed in apical middle, the impression flanked on either side by a nipple-like tooth, the teeth widely separated; hind tibiae uniformly rufous; ovipositor less than half as long as abdomen..*meteori* Howard.

Black; tergites 2 to 4 not aciculate at base; clypeus not apically impressed, the two teeth very close together or wanting..... 1.

1. Clypeus without a protruding brush of long hairs, the hairs appressed; mandibles, scape below, and tegulae whitish; nervulus slightly antefurcal; first tergite in profile decurved and increasing gradually in thickness from base to apex, the dorsal carinae rather weak, becoming obsolete far from the apex; hind tibiae, tarsi, and second joint of trochanters black; ovipositor three-fourths as long as abdomen.....*tibialis*, new species.

Clypeus with a protruding brush of long hairs arising near base; mandibles and tegulae reddish piceous, scape immaculate below; first tergite in profile thickest at spiracles, the dorsal carinae strong and reaching nearly to apex, ...*pimplae* Howard.

BATHYTHRIX TIBIALIS, new species.

Female.—Length, 7 mm.; ovipositor, 3 mm. Head polished, impunctate; face, cheeks, and malar space clothed with long, dense, silvery pubescence, vertex and frons bare, clypeus bare except for a few appressed hairs at base, its apex with two minute nipple-like teeth placed close together; ocelli arranged in an approximately equilateral triangle; malar space slightly less than twice as long as basal width of mandibles; scape globose. Thorax polished, impunctate, clothed like the head, the propodeum completely and distinctly areolated, the areas practically smooth; nervellus broken far below the middle and slightly antefurcal; second intercubitus subobsolete.

Abdomen subpolished, clothed with very short shining pubescence; first tergite slender, evenly decurved, its spiracles in the middle, the dorsal carinae comparatively weak and becoming obsolete far from the apex; ovipositor about three-fourths as long as abdomen.

Black; mandibles and scape below, tegulae, humeral spot, front coxae, and front and middle trochanters yellowish to whitish; hind tibiae and tarsi and apical joint of hind trochanters blackish; legs otherwise stramineous to testaceous, the pale color in front; wings hyaline; veins and stigma dark, the latter pale at apex.

Male.—Aside from sexual differences, very like the female and differing principally in the paler color of the mandibles, tegulae, and spot on the scape and the greater extent of the last.

Host.—*Ametastegia glabrata* (Fallén). Probably secondary.

Type-locality.—Wenatchee, Washington.

Type.—Cat. No. 20772, U.S.N.M.

Described from four females reared by E. J. Newcomer, Bureau of Entomology, April 12, 11, and 14, 1915, the type and paratype *a* and *b* (Quaintance No. 11422), and May 12, 1916, paratype *c* (Quaintance No. 14020), and one male labeled Vancouver, 2234, Coll. C. F. Baker.

Allied to *pimplae* Howard, but easily distinguished by the characters made use of in the key.

Genus AENOPLEX Foerster.

The following key includes those North American species that have been referred to this genus and one new species described herewith. It is very likely that a number of other species described in the genus *Hemiteles* should be referred here.

Mesoscutum opaque, minutely granulate, at most obscurely punctate in male...1.
Mesoscutum polished or subopaque with distinct punctures.....2.

1. Propodeum with areola less than half as wide at base as at apex.
betulaecola Ashmead.
Propodeum with areola about two-thirds as wide at base as at apex.
plesiotypus Cushman.

2. Mesoscutum subopaque, finely punctured; abdomen entirely black; ovipositor nearly as long as abdomen.....*nigrosoma*, new species.
Mesoscutum highly polished; abdomen usually more or less red (frequently entirely black in male); ovipositor not nearly as long as abdomen.....3.

3. Propodeum strongly rugose, the rugosity partially obscuring the carinae, the petiolar area deeply excavated; coxae black. (Known only from male type.) (Alaska).....*rufipes* Ashmead.
Propodeum weakly sculptured, the carinae distinct, the petiolar area flat; coxae red.....4.

4. Propodeum nearly perpendicular behind, areola distinctly wider than long; abdomen red except petiole, smooth; flagellum pale brown at base; legs very stout. (Known only from female type.).....*argeae* Viereck.
Propodeum steeply declivous behind, areola about as long as wide; abdomen red only in middle, frequently (especially in male) entirely black, more or less coriaceous; flagellum entirely black; legs moderate.....*carpocapsae* Cushman.

AENOPLEX PLESIOTYPUS Cushman.

By recent rearings the range of this species is extended to include Wenatchee, Washington, and Vienna, Virginia, the former record by Mr. E. J. Newcomer and the latter by the present writer. All of the new specimens, two males and a female from Washington and one male from Virginia, are from the type host, *Carpocapsae pomonella*. The only character employed in the original description to distinguish *plesiotypus* from *betulaecola* Ashmead that holds in the light of these new specimens is the form of the areola, and it is doubtful if the two are really distinct species. One hesitates, however, to synonymize the two because of biological differences, *betulaecola* having been reared only as a gregarious parasite of a noctuid, *Apatela betulae*, and *plesiotypus* only solitarily from the tortricid, *Carpocapsa pomonella*. In *plesiotypus* the temples are slightly less strongly rounded and the ocelli slightly smaller than in *betulaecola*, though both of these characters show some variation.

The male differs from the female principally in its somewhat coarser sculpture, narrower first tergite with stronger dorsal carinae, stouter tapering flagellum, and in having the scape beneath, the front and middle coxae, and all the trochanters white to stramineous; one has the hind coxae piceous above.

AENOPLEX NIGROSOMA, new species.

Female.—Length, 7.5 mm.; antennae, 4.5 mm.; ovipositor, 3.5 mm.

Head swollen, granularly subopaque, minutely but distinctly punctured; temples rounded, slightly sloping; cheeks strongly rounded; malar space shorter than basal width of mandibles; antennae but little more than half as long as body, 24-jointed. Thorax dorsally sculptured like the head, laterally polished, longitudinally striato-punctate; notauli rather weak; propodeum transversely striate, rounded above, nearly perpendicular behind, carinae strong, strongly mucronate at upper hind angles, areola about as long as wide, half as wide at base as at apex, petiolar area somewhat concave; legs rather slender, the inner spur of hind tibia barely one-third as long as basitarsus. Abdomen about one-third longer than head and thorax, three basal tergites granularly opaque, apical tergites polished; first tergite nearly four times as wide at apex as at base, the dorsal carinae strong and extending nearly to the apex; ovipositor nearly as long as abdomen.

Black; mandibles piceous, maxillary palpi black at base, with three apical joints pale; legs reddish testaceous, front pair slightly the palest, hind tibiae at apex and their tarsi infuscate; wings iridescent, very slightly brownish stained, veins and stigma dark brown, wingbase white.

Male.—Length, 5.5 mm.; antennae, 3 mm.

Very like the female, the principal difference consisting in the relatively narrower propodeal areas and tergites, the areola being distinctly longer than wide and the first tergite less than three times as wide at apex as at base, the slightly paler legs, and entirely hyaline wings.

Host.—*Ametastegia glabrata* (Fallén).

Type-locality.—Wenatchee, Washington.

Type.—Cat. No. 20774, U.S.N.M.

The type series consists of five females and one male, reared by Mr. E. J. Newcomer, of the Bureau of Entomology, during April, 1915 (Quaintance No. 11422), and May, 1916 (Quaintance Nos. 14017 and 14021). The paratypes, all females, exhibit variation in size down to 4.5 mm., with the legs paler, the ovipositor relatively longer, and the sculpture of head and thorax weaker.

AENOPLEX CARPOCAPSAE Cushman.

Since the publication of this species several more specimens have been reared, including a number of males. All but one are from the type-locality and type host, the exception being a male reared March 31, 1913, at Dewitt, Georgia, from *Enarmonia caryana*, under Quaintance No. 9178.

The male differs from the female principally in the relatively narrower propodeal areas and abdomen, in having the mandibles, coxae, and trochanters paler, and all but one have a distinct pale spot on the scape. The abdomen is in every case entirely black, except for the narrow whitish margins of the apical tergites.

Genus SPILOCRYPTUS Thoms.

SPILOCRYPTUS POLYCHROSIDIS, new species.

Female.—Length, 5.5 mm.; antennae, 4 mm.; ovipositor, 0.8 mm.

Head polished, face and lower orbits granularly opaque; vertex declivous behind the ocelli, the occipital carina subangulate medially; temples strongly rounded; clypeus prominent, with a few rather long hairs; cheeks flat; malar space about as long as basal width of mandibles; antennae slender, flagellum slightly thicker at apex than at base, first joint about four times as long as thick, distinctly longer than the second. Thorax opaque, minutely punctate above and distinctly striate laterally; notauli distinct, meeting before the posterior margin; propodeum opaque, declivous behind, with two complete transverse carinae; legs slender; wings large, areolet rather small, its sides convergent, radial cell short, reaching barely half way to apex of wing, nervellus postfurcal, broken below the middle. Abdomen about a third longer than head and thorax, broadest at apex of third tergite, minutely densely punctate, polished and im-

punctate toward apex; first tergite rather slender, twice as wide at apex as at base, the spiracles protuberant, situated at about the apical two-fifths; ovipositor about one-third as long as abdomen.

Head black with clypeus and mandibles reddish; antennae black, with a few basal joints reddish piceous below and an incomplete white annulus embracing the dorsal surface of flagellar joints five to nine. Thorax ferruginous with a tendency to piceous above, especially on pronotum and in the alar region; legs reddish testaceous, with a tendency to piceous on the coxae, especially the front pair, front and middle trochanters whitish, hind tibiae fuscous, with an indistinct whitish basal annulus, their tarsi fuscous with the second joint entirely and the first at base white; tegulae white; wings hyaline, veins and stigma pale brown. Abdomen ferruginous with tergites beyond fourth black and with an indication of the apical white spot characteristic of the genus.

Male.—Length, 5 mm.; antennae, 5 mm.

Structurally but little different from the female; antennae as long as body, more uniform in diameter, slightly attenuate near apex, articulation less distinct; abdomen more slender throughout. Mandibles, clypeus, and an elongate spot in lower anterior orbits white; antennae intense black except for pale lower surface of scape and the white annulus, which is complete, but embraces only four segments (ninth to thirteenth). Thorax black with scutellum, propodeum, and part of mesopleura and metapleura ferruginous; legs similarly though more contrastingly colored, the white embracing both the second and third hind tarsal joints. Abdomen without a trace of the white apical spot, and with the fourth tergite partly blackish and the fifth partly reddish.

Host.—*Polychrosis viteana* Clemens.

Type-locality.—North East, Pennsylvania.

Type.—Cat. No. 20775, U.S.N.M.

A considerable series of both sexes is at hand reared by the writer and his associate, Mr. Dwight Isely, from pupae of the grape-berry moth under Quaintance No. 11016. These show marked variations in color. In the darkest female specimen (paratype *a*) the head and thorax are entirely black, except for a slightly paler color about the mouth, the hind coxae and trochanters are black, all the tergites beyond the third are black and the first three are black at the base. and the flagellar annulus embraces only four joints, but the hind tibia and tarsi show almost no trace of the contrasting color pattern. In paratype *b* both head and thorax, including even the mouth, are black, but the abdomen and legs are as in the type. The palest female specimen (paratype *c*) has head and thorax entirely red with practically no trace of infuscation, but is otherwise very typical. The other female paratypes show the encroachment of the dark color in varying degrees.

The male paratypes display as much and similar variation. The clypeus, scape, lower orbits, and scutellum vary from white to piceous or black, but the general body color does not determine the color of these parts. Paratype *i*, for instance, is otherwise very similar to the allotype, but all of these parts are especially pale, the white embracing in addition the cheeks and a spot above the clypeus. Paratype *k*, on the other hand, which is not otherwise darker than the type, has the entire face black, the scape and scutellum piceous, the clypeus piceous with a minute yellowish spot, and the mandibles stramineous. In none of the specimens is the thorax entirely black nor entirely red, the allotype displaying nearly the maximum of black and paratype *l*, in which the mesoscutum is dark fuscous, the maximum of red. In the latter specimen the white of the hind tarsi embraces also the fourth joint and on the left leg the black of the first joint is only faintly indicated.

This species has also been reared from the same host at Put-in-Bay, Ohio, under Quaintance No. 14433, by Mr. E. R. Selkregg, of the Bureau of Entomology.

Genus CAENOCRYPTUS Thomson.

No specimen of either of the species originally included in this genus by Thomson is available for study, but the species described below runs here in the tables (of both Ashmead and Thomson) to the tribe Cryptini. Both of these tables are difficult to use with certainty because of the variability of the characters and the large numbers of comparative words employed. The present species possesses most of the characters which Thomson says "usually," "not rarely," or "frequently" exist as well as the very few characters which he states positively.

CAENOCRYPTUS NEWCOMERI, new species.

Female.—Length, 9 mm.; antennae, 7 mm.; ovipositor, 2 mm.

Head transverse, roundly sloping behind the eyes, punctate, strongly so in middle of face and frons, cheeks subpolished, clothed with short, dense, appressed, inconspicuous pubescence; malar space shorter than basal width of mandible; clypeus sparsely punctate and with rather long hairs at base, apical half polished, without hairs or punctures, with short median tooth flanked on either side by a transverse impression; antennae slender, the flagellum slightly thicker toward apex than at base, first joint of flagellum slightly longer than second, about five times as long as wide at apex. Thorax clothed like the head; pronotum laterally striate; mesoscutum and scutellum punctate, notauli strong, subfoveate; meso- and metapleura and propodeum densely, strongly, more or less reticulately punctate; propodeum with both transverse carinae strong, the apical carina especially so at the

hind angles, the basal median area complete, the pleural carinae weak; legs slender, front tibiae slightly swollen, hind tarsi longer than their tibiae by about the length of the last joint, first joint fully as long as the next three together, last longer than third, middle and hind tibiae with scattered spines, each set in a rather large puncture; areolet pentagonal, complete, its sides convergent, lower outer angle of second discoidal cell right, nervellus postfurcal, broken slightly below the middle, abdomen longer than head and thorax, first tergite two and one-half times as wide at apex as at base, minutely shagreened dorsally, strongly carinate laterally from base to apex and dorsally from base to spiracles, the latter situated at about the posterior two-fifths; tergites 2 to 4 densely, minutely punctate, the rest subpolished; ovipositor scarcely half as long as abdomen, stout.

Black, with first three and part of fourth abdominal segments and the legs (mostly) ferruginous, front coxae in front, front and middle trochanters above and hind tibiae and tarsi more or less infuscate, the tarsi, except last joint, much paler than the tibiae; wings hyaline, veins and stigma brown, the latter with a small white spot at base; antennae with an incomplete white annulus on seventh and eighth flagellar joints.

Male.—Length, 10 mm.; antennae, 8 mm.

Differs from female as follows: Temples more strongly rounded; pubescence of head and thorax paler and more conspicuous, propodeal carinae weaker; front tibiae not swollen; abdomen more slender, first tergite barely one and one-half times as wide at apex as at base; antennae without annulus; mandibles, palpi, spot on clypeus, lower anterior orbits, tegulae, a small spot below, spot on scutellum, front and middle trochanters, third and fourth joints and apical half of second joint of hind tarsi white; front coxae black in front; red color of abdomen embracing first five segments.

Host.—*Ametastegia glabrata* (Fallén).

Type-locality.—Wenatchee, Washington.

Type.—Cat. No. 20776, U.S.N.M.

A large series shows variation in size among females from 9 to 5.5 mm. and among males from 10 to 5 mm. The red color varies from ferruginous to pale testaceous, the paler color generally found in the smaller specimen. In some specimens the coxae are all red, while in others the front coxae are entirely black. The extent of the infuscation in the hind tibiae is also very variable. In some specimens the white annulus includes portions of the sixth and ninth flagellar joints, while in others it is confined mostly to one joint, the eighth. The white of the hind tarsi of the male is frequently entirely confined to the third and fourth joints. The front coxae in the male vary from almost entirely black to almost entirely red and the trochanters are frequently entirely red.

The entire series was reared under Quaintance Nos. 11,423, 14010, 14014, and 14016 by Mr. E. J. Newcomer, of the Bureau of Entomology, for whom the species is named.

Genus CHAERETYMMA Foerster.

Only one North American species has been referred to this genus. This is *C. ashmeadii* Harrington. The new species described below is not closely allied to *ashmeadii* and should, perhaps, not be placed in the present genus, but it is rather closely allied to *anatorius* Gravonhorst, which Schmiedeknecht refers to *Chaeretymma.*

CHAERETYMMA MINUTA, new species.

Female.—Length, 4.5 mm.; antennae, 3 mm.; ovipositor, 2 mm.

Head swollen, polished, impunctate except minutely on face, temples rounded, sloping; malar space slightly longer than basal width of mandible; cheeks slightly convex; clypeus broadly rounded at the apex, with a transverse impression just before the apex; scape attenuate toward base, first joint scarcely twice as long as thick, the joints decreasing gradually in length and increasing in thickness toward apex. Thorax polished, nearly impunctate above, laterally with pronotum striate, mesopleura punctate, metapleura granular; propodeum granular above, irregularly striate behind, incompletely areolated, the entire dorsal area bounded by the lateral and apical carinae being noncarinate, apical carina rather prominent at upper angles; nervellus broken very close to submediella. Abdomen equal in length to head and thorax; first three tergites granularly opaque except at apices, their apices and remaining tergites polished; first tergite about three times as wide at apex as at base, dorsal carinae weakly developed at base, obsolete beyond middle; ovipositor very nearly as long as abdomen.

Black; mandibles, clypeus, palpi, and antennae piceous, the last without a white annulus; legs testaceous, hind tibiae at apex and their tarsi fuscous; wings hyaline, veins and stigma dark brown.

Male.—Length, 6 mm.; antennae, 4 mm.

Differs from female as follows: Antennae tapering, the joints less distinct; tergites narrower, the first barely twice as wide at apex as at base; antennae intensely black, the scape with a whitish spot below; face except a triangular spot with its base at the antennae, whitish as are also the cheeks, mandibles, palpi, tegulae, and front coxae and trochanters in front; hind tibiae and tarsi darker than in female; hind coxae and trochanters with dark spot above.

Host.—Ametastegia glabrata (Fallén).

Type-locality.—Wenatchee, Washington.

Type.—Cat. No. 20777, U.S.N.M.

Described from one specimen from each sex reared by Mr. E. J. Newcomer, the type, May 22, 1915, under Quaintance No. 11422 and the allotype May 25, 1916, under Quaintance No. 14018.

SCAMBUS EPHIALTOIDES, new species.

In its long, slender form and remarkably long ovipositor this species is suggestive of the genus *Ichneumon* (=*Ephialtes*). It also resembles more closely than does any described North American species the genotype, *Scambus sagax* Hartig.

Female.—Length, 9 mm.; antennae, 5 mm. (the antennae of the type are broken, the antennal measurement being taken from a paratype female of the same size); ovipositor, 9 mm.

Head polished, impunctate, very thick antero-posteriorly, with the temples nearly as broad as the eyes and very strongly rounded to the weak occipital carina; eyes large, slightly converging toward the clypeus and very slightly emarginate opposite the antennae; postocellar and ocell-ocular lines equal and slightly greater than the diameter of a lateral ocellus; face short, elevated medially; clypeus short, medially impressed, and with a deep triangular emargination, malar space very short, cheeks strongly convex. Thorax slender, subcylindrical, polished, weakly punctate, pronotum and mesopleura impunctate; notauli strong anteriorly but soon obliterated, prescutum gibbous; propodeum with sparse suberased punctures, the carinae extending nearly to the apex; radius originating before middle of stigma, nervellus broken close to brachiella and very strongly antefurcal; legs slender, the hind coxae in their greatest width barely two-thirds as wide as long. Abdomen slender, more than one and a half times as long as head and thorax together; first tergite very small, at its apex scarcely half as wide as apex of second; tergites 2–5 strongly punctured except for their polished apices, others obscurely roughened; ovipositor slender, compressed, as long as body.

Black; clypeus entirely and mandibles toward their apices piceous; palpi pale fuscous; antennae black, scape at apex and pedicel outwardly piceous; wings hyaline with brownish stain, veins and stigma brown, except costa and metacarpus, which are whitish, tegulae white, stramineous at apices; hind legs with coxae black, basal joint of trochanter piceous at base, second joint and apex of first whitish, femur reddish testaceous, tibia fuscous with a paler basal annulus and elongate spot above at middle, tarsus fuscous with an obscure paler annulus at base of first joint; other legs with same color pattern, but with the colors paler and less contrasting, especially in the front legs, where the black becomes piceous and the fuscous pale testaceous to stramineous.

Male.—Length, 7 mm.; antennae, 4 mm.

Differs from female principally as follows: Head even longer antero-posteriorly, malar space nearly obliterated; front femur

deeply impressed below, the tibia strongly curved and flattened below so that when the two are brought together a large opening is left; abdomen more slender, first tergite twice as long as wide at apex and equal in length to second, which, as naturally folded, is parallel-sided; palpi and pedicel white; wings clear hyaline; hind tibia mostly piceous; front and middle legs except coxae stramineous to white; front and middle coxae white at apices.

Host.—*Evetria siskiyouana.*

Type-locality.—Colestin, Oregon.

Other localities.—Corlett, Montana; Crescent City, California; Siskiyou, Oregon; Ashland, Oregon.

Type.—Cat. No. 20778, U.S.N.M.

The single paratype female (paratype *a*) is very like the type with the leg color somewhat darker. The five paratype males exhibit considerable variation both in size and sculpture. The largest is 7.5 mm. long and the smallest 5 mm. Paratypes *b* and *c* are very like the allotype; *d* has the pedical piceous and the hind femur with a large reddish spot on each side; *e* has the front and middle femora piceous above, and *f* has the middle femur mostly and the tibia at apex and below piceous.

Described from the above-mentioned eight specimens, the type and allotype reared under Hopkins U. S. Nos. 12538n^2 and 12538nnn^2 from the type host in cones of *Abies concolor;* paratypes *a*, *b*, and *c* under Hopkins U. S. Nos. 12560e^2, 13298*hh*, and 12560*ig*, respectively, from cones of *Abies concolor*, the first and last at Ashland and the second at Siskiyou; paratypes *d* and *f* under Hopkins U. S. No. 12557*l* from cones of *Picea sitkensis* at Crescent City and paratype *e* under Hopkins U. S. No. 12509*b* from cones of *Picea engelmanni* at Corlett.

ITOPLECTIS OBESUS, new species.

Female.—Length, 8 mm.; ovipositor, 1.5 mm.

Very stout, the thorax very nearly as high as long; head much narrower than thorax and set very close to the very short vertical pronotum; prescutum medially extending slightly farther cephalad than upper margin of pronotum; propodeum declivous throughout; abdomen very broad, tergites 3–5 very transverse, more than twice as wide as long; ovipositor less than one-third as long as abdomen; legs very stout, posterior femora less than three times as long as deep.

Face rounded, strongly, rather densely punctured and together with mandibles and malar space clothed with long, dense, cinereous pubescence; clypeus at base sparsely punctured, in the middle deeply impressed, the impression polished, at apex roundly truncate and with a single row of punctures; malar space only about one-third as long as basal width of mandibles; antennae inserted far above middle of eyes, the latter deeply emarginate opposite antennae; frons, occiput, and cheeks sparsely, weakly punctured, polished; ocelli large and

close to each other, postocellar line equal to diameter of posterior ocelli and twice as great as ocell-ocular line.

Pronotum polished; mesoscutum as wide as long, densely though weakly punctured, with very short, fine, whitish pubescence, and with practically no trace of notauli; mesopleura and mesonotum sculptured and clothed about as mesoscutum except in region of punctiform fovea, where it is highly polished and without vestiture, the fovea very deep; metapleura polished, almost without sculpture or vestiture; propodeum laterally with dense punctuation and vestiture, medially and posteriorly polished and without vestiture, the longitudinal carinae very short, divergent and widely separated at base; spiracles large, oval, about two-thirds as wide as long; legs very stout, front tibiae much shorter than their femora, front claws toothed at base.

Abdomen finely, very densely punctured and clothed with very short whitish pubescence; first tergite about as wide as long, dorsal carinae weak except at extreme base, anterior declivity embracing two-thirds of total dorsal length; other tergites, especially second and third, with apical impression and lateral elevations well developed; terminal tergites subpolished and weakly punctate; ovipositor short, stout, the sheath with very short, dense, black pubescence.

Black, with legs largely red, apices of tergites 2–4 very narrowly dark piceous; humeral spot, wing bases, and tegulae white, the latter brown at apex; antennae black, slightly paler at extreme apex; labial palpi black, labial palpi blackish at base; wings hyaline, veins and stigma blackish, the latter pale at apex and base; front coxae black except at apex, hind femora black at apex, hind tibiae black with a white annulus in about the second fourth, their tarsi black, the first three joints white at base, front and middle tibiae and tarsi with same color pattern but less distinct, the black being replaced by ferruginous on the middle legs and by stramineous on the front legs, except that the basal annulus of the middle tibia is black.

Male.—Length, 6 mm.

Differs from female as follows: Less stout, the thorax considerably longer than wide, malar space somewhat longer; all coxae black, hind pair pale only at apex, middle and front pair pale at apex and in front; all palpi white.

The single paratype female is very like the type.

Host.—Type and paratype from fruit-tree leaf-roller. Allotype from bud-moth.

Type-locality.—Wenatchee, Washington.

Type.—Cat. No. 20779, U.S.N.M.

Described from the above-mentioned two females and one male reared from pupae of the hosts June 17 (paratype), June 19 (type), and July 9 (allotype) by E. J. Newcomer, under Quaintance Nos. 11436 and 11440.

The closest described American relative of this species is *I. behrensi* (Cresson), but it is much more closely allied to the European *I. alternans* (Gravonhorst), from which it can be distinguished only by the darker antennae, wing veins, and stigma.

GLYPTA EVETRIAE, new species.

Female.—Length, 8 mm.; antennae, 6 mm.; ovipositor, 6 mm.

In Cresson's table to the species of *Glypta* this species runs to *varipes* Cresson. Compared to a homotype (Rohwer) of *varipes* differs as follows: Temples as broad as eyes, not sloping inward; malar space narrower than basal width of mandibles; eyes distinctly shorter than width of face; cheeks in front view very strongly rounded below eyes; clypeal suture straight in middle; antennae shorter, black, not paler toward apex; labial palpi and first and second joints of maxillary palpi blackish; propodeum with costulae entirely obsolete, posterior face slightly longer than dorsal face; abdomen stouter, first tergite about as wide at apex as long; wing veins and stigma blackish; legs dark ferruginous, hind tibiae with basal dark annulus incomplete, their tarsal joints more narrowly white at base.

Male.—Length, 7 mm.; antennae, 6 mm.

Differs from female principally in having the front legs paler and hind coxae, trochanters, and femora infuscate above.

Host.—*Evetria taxifoliella* Busck.

Type-locality.—Ashland, Oregon.

Other locality.—Missoula, Montana.

Type.—Cat. No. 20780, U.S.N.M.

Described from five females and four males reared from the host in cones of *Pseudotsuga taxifolia* at the type-locality under Hopkins U. S. No. 13209*ba*, these being part of a large series. The paratypes *a–d*, female, and *e–g*, male, exhibit variations from the types principally in size and depth of leg color.

NOTES ON THE SHELLS OF THE GENUS EPITONIUM AND ITS ALLIES OF THE PACIFIC COAST OF AMERICA.

By William Healey Dall,
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The genus called by Lamarck, in 1799, *Cyclostoma* (type, *Turbo scalaris* Linnæus) is more commonly known by the name of *Scalaria*, which he adopted in 1801. As this shifting of a name once given is inadmissible under the rules of nomenclature we are obliged to look further for the proper name of the genus.

In the anonymous Museum Calonnianum printed by the dealer, George Humphrey, after a manuscript of Hwass in 1797, the name *Scala* is used, and for some years the present writer adopted it for the genus. However, the inconveniences incident to the adoption of the nomenclature of this publication are so great that the International Committee on Zoological Nomenclature have decided to expunge it from the list of works to be cited in nomenclature, and the next name in order, *Epitonium* of Bolten in 1798, must be adopted.

The group is distributed all over the world and is usually rich in species, but sparse in individuals in any given fauna. E. de Boury has given much attention to it, and it is to be hoped his proposed monograph may not long be delayed since such excellent illustrations of the species as those he has published on minor groups are urgently needed to identify the many closely related forms. Many of the older descriptions are so brief as not to permit of the differentiation of similar species, and even the figures, especially of the smaller species, are more or less inadequate.

Among the principal features serving to identify the species are the presence or absence of spiral sculpture, of an umbilical perforation, and of a basal cord or disk. The number of the varices is, on the whole, very constant in most of the groups, following the rule that the greatest variation will be found where the normal number of varices is greatest. In a species with few varices the number is remarkably constant, except in the group typified by *E. lineatum* Say, where the number is irregular and the varices coarse and very few. The nucleus or nepionic shell is pretty uniform throughout the group, usu-

ally smooth, elevated or turbinate, and often of a darker color than the rest of the shell.

De Boury has divided the genus into a multitude of sections, which have a certain convenience in separating the species, but which in most cases tend to merge into the adjacent groups without any very marked distinction.

The Pacific coast of America is quite rich in species and doubtless there are many more tropical forms yet to be discovered. The South American coast has been very imperfectly explored and very few species have been reported therefrom. The older authors described very briefly and imperfectly quite a number of species which can only be identified by comparison with the original types, most of which are in the collection of the British Museum. Perhaps the best and most complete single collection is that brought together by De Boury and situated in the Paris Museum.

Owing to gross carelessness on the part of the compilers there are many erroneous localities given in several of their monographs. Species from the Philippines are ascribed to the Pacific coast of America, and quite incompatible localities are given to a single species. Some of these blunders will be corrected in the present paper.

The most common of our boreal species is *Epitonium* (*Boreoscala*) *greenlandicum* Perry, 1811, with which *subulatum* Couthouy, 1838 (not of Sowerby, 1825), and *planicosta* Kiener, 1838 (not *planicostata* Bivona, 1842), are synonymous. The subgenus *Boreoscala* was instituted by Kobelt in 1902; *Arctoscala* Dall, 1909, and *Liroscala* De Boury, 1909, are synonymous. Its distribution is circumboreal, though somewhat patchy, as it is often apparently absent where it would be expected. On the Pacific coast it is found from Point Barrow to Wrangell, Alaska, and the coast of Eastern Siberia; it is fossil in the Pleistocene terraces of Japan. It exhibits much more variability than the more southern species, both in slenderness and in the number of axial ribs, which vary from 8 to 17 in number, and also in the strength of these ribs. The strong spiral sculpture seems to be tolerably constant. *E. hemphilli* Dall, 1878, from the Pliocene of San Diego, is an analogous species.

The subgenus *Opalia* H. and A. Adams, 1853 (*Psychrosoma* Tapparone Canefri, 1876), is represented on the coast by several recent species and some fine Pliocene forms. The most common recent species is *O. wroblewskii* Mörch, 1876. This is *Scalaria borealis* Gould, 1852, not of Beck, 1839. A very solid white shell with seven or eight varices, more conspicuous on the early part of the spire, and a well-marked basal disk. It ranges from Forrester Island, Alaska, south to San Diego, California, where it is found in 53 fathoms, and also in the Pleistocene of the vicinity.

Opalia varicostata Stearns, 1875 (not of Sacco, 1890), of the San Diego Pliocene, is a large species with 10 or 11 ribs sometimes partly obsolete. *O. varicicostata* Cossmann, 1912, is synonymous. The *O. anomala* of Stearns, 1875, is practically without varices except near the tip of the spire, where traces may sometimes be found. It is an *Opalia* and not a *Crassiscala*, as supposed by De Boury. The Miocene *Catenoscala oregonensis* Dall, 1909, is accompanied by a large *Boreoscala condoni* Dall, and an *Opalia* of the *varicostata* type which I called *O. rugifera*. These large Epitoniums seem to be rather characteristic of the Northwest Coast Miocene.

A somewhat degenerate representative of the *Opalia* group is *B. pluricostata*, new species, ranging from Forrester Island, Alaska, to San Diego. It resembles the ribbed upper portion of *O. wroblewskii* a good deal, but is smaller and more cylindrical, with eight varices. It has seven whorls without the nucleus, the varices are continuous up the spire, the interspaces smooth, the basal disk octohedral from the intersection of the ribs, somewhat concave, and relatively smaller than in *wroblewskii*. Length, 16; diameter, 5 mm. U. S. Nat. Mus. Cat. No. 56054. The type-specimen is from Neeah Bay, Washington.

Another group referred by Carpenter to *Opalia* is separated by De Boury under the name of *Dentiscala*. Representatives of this type are *D. crenatoides* Carpenter, 1864, from the Gulf of California, rather small with a coarse spiral rib on the basal disk and deep pits at the intersections of the nine axial ribs. A species which has generally been confused with this and is much more common, is *D. crenimarginata*, new species, which ranges from Monterey, California, to Puerto Libertad, Mexico. It is larger, much stouter, spirally striated, with a convex smooth basal disk, the 12 axial ribs on the last two whorls obsolete on the sides of the whorls but coronating the suture. It has 6 or 7 whorls without the nucleus, the varix at the aperture is heavy, and there is sometimes another heavy varix indicating a resting stage. Length, 16; diameter, 7 mm. U. S. Nat. Mus. Cat. No. 111207. The type-specimen comes from La Paz. A species somewhat intermediate between the two above noted, *D. insculpta* Carpenter, 1864, is found in the Pleistocene of Santa Barbara, California, but it is without the fine spiral surface sculpture.

A smaller species, *D. nesiotica* Dall, was dredged by me in 16 fathoms at Catalina Island. It has 12 varices, rather feebly carried over the whorl and obsolete on the basal disk. Sharp spiral sculpture covers the surface and the terminal varix is heavy; there are six whorls, not including a smooth nucleus of a whorl and a half; the suture is markedly coronated by the ribs. Length, 10.5; diameter, 5 mm. U. S. Nat. Mus. Cat. No. 56900.

Another group referred to *Opalia* by Carpenter has been separated by De Boury in 1889 under the name of *Nodiscala*. These are small, slender imperforate shells with ill-defined axial nodes or ribs, but only one true varix, which is terminal and much thickened. The shells when in good condition have a soft calcareous outer coat which is punctate or minutely sculptured, recalling the outer coat in *Chlamys*. Four species of this group have been described from the coast, *E. mazatlanicum* Dall, 1908; *E. retiporosum* Carpenter, 1864, ranging from Catalina Island to the Gulf of California; *E. spongiosum* Carpenter, 1864, from Monterey, California; and *E. mexicanum* Dall, 1908, from Acapulco.

A very distinct group of boreal forms is *Acirsa* Mörch, 1857 (*Arcisa* Nyst, 1873), founded on *Scalaria borealis* Beck, 1839 (not of Gould, 1852), of which *S. eschrichtii* (Hölboll) Möller, 1842, and *S. ochotensis* Middendorff, 1849, are synonyms. This species is circumboreal, the more southern specimens are more delicate and smaller than those from truly arctic waters, which at most form a variety which will take Middendorff's name. On the Pacific side this species ranges from Bering Straits through Bering and the Okhotsk Seas to the Aleutian Islands.

Curiously enough a minute form has been received from Cape San Lucas which appears to belong to this group, and if so was probably washed up from deep water. The shell is littoriniform, acute, with seven whorls, including the somewhat styliform smooth nucleus; the sutures are appressed, the whorls only moderately convex, with very faint axial indications of ribbing, and sharp uniform spiral striation. A prominent thread upon which the suture is laid marks the periphery. The terminal varix is inconspicuous, the margin of the aperture being thickened inside with little outside expansion. Length, 3.6; diameter, 2 mm. U. S. Nat. Mus. Cat. No. 74020. This may take the name of *A. exopleura*.

A slender white spirally sulcate shell from the Gulf of California, described by Carpenter as *Acirsa menesthoides* in 1864, may perhaps be referred to the genus *Couthouyella* Bartsch, 1909, but its proper place awaits for determination specimens containing the operculum and soft parts.

Ferminoscala Dall, 1908, contains large yellow or brown species with finely reticulated surface, large basal disk, and a thick heavy terminal varix. Before the varix is formed the shell has much the aspect of *Amaea magnifica* Sowerby. *E. ferminianum* Dall, 1908, ranges from Point Fermin in the Gulf of California to Panama. *E. brunneopictum* Dall, 1908, was dredged off Cerros Island, Lower California. *E. pompholyx* Dall, 1889, ranges from Cape San Lucas to the Galapagos Islands, in deep water.

The next group in order is *Asperiscala* De Boury, 1909, of which the type is the elegant *Scalaria bellastriata* of Carpenter, 1864, which has 15–16 varices and clean-cut spiral sculpture. Its ranges from Monterey to San Pedro, California. The only other described species of this group from the coast is *E. lowei* Dall, 1906, a species with 26 varices from Catalina Island. There are quite a number of hitherto undifferentiated forms of this group in the United States National Museum collection, as follows:

EPITONIUM ACAPULCANUM, new species.

Shell small, white, acute, imperforate, with a slender three-whorled smooth nucleus and five subsequent whorls; varices 11, continuous over the suture up the spire which they nearly encircle; spiral sculpture of closely adjacent flattish threads covering the whorl; anterior face of the varices smooth, without any spinosity at the shoulder. Length, 5; diameter, 2.5 mm. U. S. Nat. Mus. Cat. No. 59337. Range, La Paz to Acapulco.

EPITONIUM COOKEANUM, new species.

Shell small, pink, solid, acute, imperforate, the nucleus lost, with eight well-rounded subsequent whorls; with 10 rather solid, smooth continuous white varices making less than half a turn round the spire; spiral sculpture of extremely fine uniform threads covering the whorl between the varices; the terminal varix thicker than the others; all the varices broader at the intersection with the suture but not spinose. Length, 9.5; diameter, 4 mm. U. S. Nat. Mus. Cat. No. 211019. Range, San Diego to the Gulf of California.

This is named in honor of Miss J. M. Cooke, of San Diego, a most assiduous collector, to whom, and to the work of her late brother, the Museum is indebted for much interesting material.

EPITONIUM XANTUSI, new species.

Shell small, acute, white, thin, with seven well-rounded whorls exclusive of the (lost) nucleus; varices low, thin, sharp, 12 in number, continuous over the spire which they half encircle, but not expanded over the rather deep suture; spiral sculpture of flattish adjacent threads over the whole surface of the whorl between the varices; terminal varix hardly thicker, none of them spinose. Length, 5.5; diameter, 3 mm. U. S. Nat. Mus. Cat. No. 4107. Range, Cape San Lucas (Xantus) and La Paz, Lower California.

EPITONIUM ARNOLDI, new species.

Shell of moderate size, white, thin, with eight well-rounded whorls exclusive of the (lost) nucleus; varices on the last whorl 13, on the first four whorls they are feeble, on the next two distinct and crowded, on the last two more distantly spaced, low, and cord-like; spiral

sculpture of extremely fine close-set striae; terminal varix not enlarged, the varices not continuous over the suture nor enlarged or spinose; aperture obliquely ovoid. Length, 14; diameter, 5.5 mm. U. S. Nat. Mus. Cat. No. 106875. Range, beach at San Pedro, California, Delos Arnold.

EPITONIUM PACIS, new species.

Shell white, thin, with eight well-rounded whorls exclusive of three smooth, acute, nuclear turns; varices 18, with wider interspaces, narrow, thin, smooth, not generally continuous, with a small sharp short spine a little distance in front of the suture; spiral sculpture of, on the last whorl, about 20 sharply defined threads, mostly with wider interspaces, in which there are fine spiral striulae; there is a smooth space in front of the suture and another around the narrowly perforate umbilicus, without spiral sculpture; aperture ovoid; operculum blackish, concave, of about three whorls. Length, 12.5; diameter, 6 mm. U. S. Nat. Mus. Cat. No. 96821. Range, in the vicinity of La Paz, Lower California, in 10 to 45 fathoms.

EPITONIUM EMYDONESUS, new species.

Shell minute, white, with two smooth, polished, nuclear, and four and a half subsequent well-rounded whorls; varices 14, sharp, hardly reflected, not continuous over the suture, slightly crenulated by the spiral sculpture of distinct, close, rounded threads; base rounded, imperforate; aperture rounded. Length, 3.5; diameter, 1.7 mm. U. S. Nat. Mus. Cat. No. 194995. Range, Galapagos Islands, in 40 fathoms, sandy bottom.

EPITONIUM IMPERFORATUM, new species.

Shell small, white, with two polished nuclear and four or five subsequent rounded whorls with a deep suture and imperforate base; varices 20 or 21, low, narrow, with wider interspaces, not continuous over the suture, and having a small angle at the shoulder which gives a slightly turrited aspect to the spire; spiral sculpture of close-set similar spiral threads covering the whole surface between the varices; aperture ovate. Length, 4.5; diameter, 2.5 mm. U. S. Nat. Mus. Cat. No. 211391. Range, off La Paz, Lower California, in 26 fathoms.

EPITONIUM ONCHODES, new species.

Shell minute, white, thin, with two smooth nuclear and four rapidly enlarging subsequent whorls; base minutely perforate; varices 19, thin, low, sharp, not spinose or continuous over the very deep suture; spiral sculpture of uniform, very fine, close-set threads covering the whole whorl between the varices; aperture obliquely ovate. Length, 3; diameter, 1.5 mm. U. S. Nat. Mus. Cat. No. 211786*a*. Range, Panama Bay in 62 fathoms, sand.

EPITONIUM LAGUNARUM, new species.

Shell small, thin, white, with six rounded whorls exclusive of the (lost) nucleus; varices 16, low, narrow, widely spaced, passing over the entire whorl; spiral sculpture of extremely fine striae, with a single thread on the periphery and a stronger one, marginating the imperforate base, on which the suture is laid; aperture obliquely ovate, the margin slightly produced in front and near the suture. Length, 7.5; diameter, 3.5 mm. U. S. Nat. Mus. Cat. No. 253024. Range, Laguna Beach, California, J. J. White.

New section PICTOSCALA Dall.

In spite of the numerous sections proposed by M. de Boury, he does not seem to have designated one to receive shells of the type of *Scalaria lineata* Say, 1822 (not of Kiener, 1838). These forms have a more or less dark colored body with a feebly developed basal disk, fine spiral striation, rather numerous small varices, and a few irregularly distributed very much heavier varices, including the terminal one. A single species of this group occurs at Panama. In allusion to the coloration I propose *Pictoscala* for these forms.

EPITONIUM (PICTOSCALA) PURPURATUM, new species.

Shell small, dark purple, with seven well-rounded whorls, exclusive of the (lost) nucleus; minor varices linear, low, about 18 in number, major varices one or two, white and conspicuous; spiral sculpture extremely fine striae visible under magnification; base rounded, imperforate, the disk feebly marked; aperture ovate, the thickened margin nearly or quite interrupted over the body. Length, 10; diameter, 4.5 mm. U. S. Nat. Mus. Cat. No. 252242. Range, beach at Old Panama, Doctor MacDonald.

Epitonium (*Cirsotrema*?) *montereyense* Dall, 1907, has 11 varices and ranges from Monterey to San Pedro, California.

The subgenus *Sthenorytis* Conrad, 1862, contains some of the most noble species of this family both recent and fossil. *Stenorhytis* Cossmann, 1912, is synonymous. *Pseudosthenorytis* Sacco, 1891, does not seem to differ materially. Only one species is yet known from the Pacific coast, *S. turbinum* Dall, 1908, from 300 fathoms, near the Galapagos Islands. It has 10 varices.

Coming now to the group which has no spiral sculpture, often referred to *Clathrus* Oken, 1815, and called by De Boury *Nitidoscala* in 1908, we find the Pacific coast well supplied with species. The most conspicuous of the northern ones is *E. indianorum* Carpenter, 1865, which has 12 to 13 varices and ranges from Forrester Island, Alaska, south to Todos Santos Bay, Lower California.

A similar but more slender shell, with usually 11 or 12 varices and a narrow, purple brown line in front of the suture, is *E. tinctum* Carpenter, 1865. I consider the species quite distinct from *indianorum*

to which Carpenter referred it as a variety. It is notable that the brown line, so distinct in fresh specimens, gradually fades out in the cabinet, though kept in the dark. The range of this species is from Monterey to the Gulf of California.

In 1856 Carpenter described from Panama a species of *Nitidoscala* with eight varices, under the name of *S. hindsii*. By some confusion he transferred the name in 1865 to a well-known form from California which has 11 to 14 varices and ranges from Monterey to the Gulf of California, but so far as known does not reach Panama. For the Californian shell I propose the name of *Epitonium* (*Nitidoscala*) *fallaciosum*.

Other species are *E. subcoronatum* Carpenter, 1869 (*Spiniscala* De Boury, 1910), with 11 varices, ranging from Vancouver Island to San Diego; *E. acrostephanus* Dall, 1908, with 14 to 17 varices, ranging from Monterey to the Coronado Islands; and *E. crebricostatum* Carpenter, 1869, with 9 to 11 varices, ranging from Vancouver Island to the Gulf of California. This latter is not *S.* (*Funis*) *crebricostata* Stanley Gardner, 1876.

Undescribed forms related to the preceding are as follows:

EPITONIUM DENSICLATHRATUM, new species.

Shell white, solid, with 6 or 8 well-rounded whorls exclusive of the (lost) nucleus; varices 10 or 11, sharply axially grooved on their anterior faces, solid, thick, not continuous over the suture, on the base showing a slight flattening, though there is no basal cord or disk; aperture ovate; behind the inner margin there is a narrow flattened area reflected over the umbilical region in the type-specimen. Length, 17; diameter, 7.5 mm. U. S. Nat. Mus. Cat. No. 111209. Range, Puget Sound and Neeah Bay, Washington.

This form was segregated by Carpenter in the Stearns collection under the above name, but never published.

EPITONIUM PERSUTURUM, new species.

Shell with three smooth brown nuclear and five subsequent thin white whorls separated by an unusually deep suture; varices 10, narrow, rounded, continuous up the spire which they encircle about half way, but not expanded at the suture into which they dip; the whorls are slightly flattened above the shoulder, but there is no corresponding angle or spine on the varices. Length, 15.5; diameter, 6 mm. U. S. Nat. Mus. Cat. No. 211021. Range, beach at San Diego, California.

EPITONIUM COLPOICUM, new species.

Shell white, with one blunt nuclear and five subsequent, rapidly enlarging well-rounded whorls; varices nine, continuous over the suture, which is deep, and so expanded there as to form pit-like cavities of the interspaces; the varices are thin, sharp, rather wide, and hardly

reflected; in ascending to the apex of the shell they nearly half encircle it; base rounded, imperforate; the terminal varix does not touch the body whorl and is buttressed by the anterior ends of the preceding varices. Length, 9; diameter, 4.5 mm. U. S. Nat. Mus. Cat. No. 46213. Range, Gulf of California (Stearns).

EPITONIUM PAZIANUM, new species.

Shell chalky white, thin, smooth, with seven rounded, almost separated whorls exclusive of the (lost) nucleus; varices nine, thin, sharp, with a spinule at the shoulder, continuous over the suture into which they descend and making nearly half a turn around the spire before reaching the apex; base rounded, imperforate; aperture rounded, the inner anterior margin somewhat produced; the margin nowhere attached to the body whorl. Length, 20; diameter, 9 mm. U. S. Nat. Mus. Cat. No. 111208. Range, La Paz, Lower California, in 112 fathoms.

EPITONIUM HEXAGONUM Sowerby, 1844.

Has six varices, as its name implies, and this number seems invariable. The shell is pure white, the smoothness and regularity of its shape are very pleasing and give, together with its solidity, a special aspect to the species. It ranges from Santa Cruz, California (Button, collector) to Panama.

EPITONIUM PROPEHEXAGONUM, new species.

Shell of 10 whorls, livid flesh color with white varices, otherwise closely resembling *E. hexagonum* in form but larger; rarely with seven varices; first whorl of the nucleus small, smooth, white; second with 12 low rounded varices; subsequent whorls with the normal six continuous over the suture, half encircling the spire, finely striated on the anterior face, a slight angle at the shoulder but much less prominent than in *E. hexagonum*. Length, 21; diameter, 9.5 mm. U. S. Nat. Mus. Cat. No. 153075. Range, Gulf of California and Mazatlan.

Adult *hexagonum* measures about 14 mm. in length and 6 in diameter, and is relatively more acute with apparently deeper suture. The varical angle is only fully developed on the later whorls, when it is often spinose. The front of the varices is not striated.

EPITONIUM EUTAENIUM, new species.

Shell small, thin, slender, white, acute, with eight whorls, including the blunt smooth nucleus; varices eight, low, narrow, sharp, continuous over the deep suture into which they dip; a slight angle at the shoulder, the front face of the varices smooth; aperture transversely oval, the lateral margins slightly produced. Length, 11; diameter, 4 mm. U. S. Nat. Mus. Cat. No. 201201. Range, Gulf of California.

EPITONIUM APICULATUM, new species.

Shell small, white, with a smooth slender elevated nucleus of two and a half whorls and five rapidly enlarging subsequent whorls; varices eight, sharp, high, thin, with an acute angle at the shoulder, continuous over the deep suture into which they dip, half encircling the spire; on the base the varical edges are flatly reflected; on the later whorls the shoulder angle becomes a prominent spine; aperture ovate, slightly produced in front. Length, 4; diameter, 2 mm. U. S. Nat. Mus. Cat. No. 111219. Range, Lower California to Panama Bay, in 30 fathoms.

EPITONIUM COMPRADORA, new species.

Shell minute, white, with a very small acute nucleus of two and a half smooth whorls and five or more rapidly enlarging subsequent whorls separated by a rather deep suture; varices 13, with a blunt angle at the suture, giving the profile of the whorls a somewhat tabulate aspect; varices thin, sharp, erect; base rounded, aperture subovate, anterior faces of the varices smooth. Length, 4; diameter, 2.5 mm. U. S. Nat. Mus. Cat. No. 105527. Range, Point Abreojos, Lower California, to the Gulf of California,

Possibly immature, but apparently distinct from the young of any of the allied species.

EPITONIUM CYLINDRICUM, new species.

Shell small, white, thin, subcylindrical, with five whorls exclusive of the (lost) nucleus; suture moderately deep; varices 13, low, thread-like, not continuous over the suture, not angulate; base evenly rounded, aperture subovate. Length, 4; diameter, 1.5 mm. U. S. Nat. Mus. Cat. No. 271037. Range, near La Paz, Lower California, in 21 fathoms.

EPITONIUM CENTRONIUM, new species.

Shell small, white, acute, slender, with three elevated smooth nuclear and about five subsequent whorls; suture deep; varices nine, thin, sharp, erect, with a spinose angle about halfway between the suture and the periphery, continuous over the suture on the spire which they nearly encircle; terminal varix duplex, anterior faces of the varices striated; aperture rounded, the inner margin buttressed by the preceding varices, not touching the body whorl. Length, 4.5; diameter, 2 mm. U. S. Nat. Mus. Cat. No. 211395. Range, Gulf of California, in 7 to 26 fathoms.

EPITONIUM TIARA Carpenter, 1856.

This species has 12 varices and ranges from Catalina Island to Todos Santos Bay, Lower California, according to specimens so named by Carpenter in the Stearns collection. It was originally described

from Panama, and I feel some doubt as to whether the Californian species is conspecific with that from Panama, but the question can only be settled by a comparison with the type in the British Museum.

EPITONIUM COLUMBIANUM, new species.

Shell acute, yellowish white, with nine whorls exclusive of the (lost) nucleus; varices 18, low, rounded, more or less striated, without any angulation, continuous over the suture into which they dip and nearly encircling the spire; the type-specimen has the interspaces more or less finely axially striated, but the southern specimens seem quite smooth; base and aperture rounded, the anterior margin of the latter slightly angular. Length, 21; diameter, 7.5 mm. U. S. Nat. Mus. Cat. No. 111211. Range, off the Columbia River, Oregon, in 27 fathoms, and south to Point Abreojos, Lower California, in 44 fathoms.

The most prominent characteristic of this species is the regularity of all its features. It is the largest of those species of the coast which have unarmed varices.

EPITONIUM SAWINAE Dall, 1907.

This species has 16 to 19 varices more or less flatly reflected on the base, and ranges from Vancouver Island to San Diego, California, and possibly to the Gulf of California.

EPITONIUM SAWINAE, variety? CATALINENSE, new variety.

Shell with a small three-whorled nucleus, smooth and white, and seven and a half subsequent whorls; varices 22 to 24, not spinose or angular, not regularly continuous over the suture, with the anterior faces of the varices finely lamellose or deeply striated. Base rounded with a minute umbilical perforation in the adult; aperture nearly circular. Length, 13.5; diameter, 6 mm. U. S. Nat. Mus. Cat. No. 109502. Range, off Catalina Island, California.

It differs from *sawinae* by the absence of angularity on and the greater number of the varices, and by the umbilical perforation.

EPITONIUM MONTEREYENSE, new species.

Shell small, white, rather solid, with six whorls, exclusive of the (lost) nucleus; varices 14, low, rather solid, striated, not angulated, largely continuous over the suture, encircling about one-fourth of the spire, widely flatly reflected on the base, the reflection covering at least half the interspace, the whole giving the effect of a disk though there is no basal disk or cord; aperture subovate, the anterior margin somewhat produced. Length, 6; diameter, 2.5 mm. U. S. Nat. Mus. Cat. No. 111217. Range, Monterey Bay, in 30 fathoms.

EPITONIUM CALIFORNICUM, new species.

Shell small, white, solid, with seven whorls and a very small brownish nucleus of a whorl and a half; varices 9 or 10, low, sharp, reflected, anteriorly axially striated, with a very small sharp spine at the shoulder; suture deep, the whorls almost separated, rounded; base rounded, imperforate; aperture short-ovate, its inner margin resting on the preceding varices, not touching the body of the whorl. Length, 10.5; diameter, 4 mm. U. S. Nat. Mus. Cat. No. 201202. Range, San Miguel Island, California, to the Gulf of California.

EPITONIUM RECTILAMINATUM, new species.

Shell minute, whitish, with three polished blunt nuclear and four subsequent whorls; varices 18 or 19, low, uniform, straight, not continuous over the suture, with equal interspaces, sharp and erect; without angle or spine; base rounded, imperforate; aperture rounded, slightly oblique. Length, 3.5; diameter, 1 mm. U. S. Nat. Mus. Cat. No. 110430. Range, Monterey Harbor, California, in 12 fathoms, to the Gulf of California. A quite similar but more rapidly increasing species is found at the Galapagos Islands, in 634 fathoms, but the specimen is too immature to name.

EPITONIUM CAAMANOI Dall and Bartsch, 1910.

Has 12 varices rather broadly and flatly reflected and comes from Barkley Sound, Vancouver Island, in 7 to 10 fathoms.

EPITONIUM TABULATUM, new species.

Shell slender, acute, thin, dull white, with two and a half smooth nuclear and 12 or more subsequent whorls; varices 16, thin, sharp, well reflected, anteriorly striated, with a blunt angle at the shoulder, behind which the varix is somewhat concave, giving a tabulate profile to the whorls; the varices more than half encircle the spire, being continuous over the spire; in perfect specimens there is a very thin calcareous outer layer to the shell; base rounded, aperture rounded, the reflected margin narrow. Length, 18; diameter, 7.5 mm. U. S. Nat. Mus. Cat. No. 109569. Range, San Pedro, California, to the Coronado Islands.

The length given above is of the decollate type specimen of five whorls; the entire length, if perfect, would be about 25 mm. It is a *Crisposcala*.

EPITONIUM APPRESSICOSTATUM, new species.

Shell slender, acute, white, with two and a half smooth nuclear and six or seven subsequent whorls; varices 13, low, flat, closely appressed to the whorl, continuous over the suture and nearly half encircling the spire; suture moderately deep, base rounded, imperforate, aperture subovate, the margin slightly angular in front.

Length, 14; diameter, 4.5 mm. U. S. Nat. Mus. Cat. No. 59334. Range, Acapulco, Mexico.

EPITONIUM MUSIDORA, new species.

Shell thin, white, slender, with an acute spire and deep suture; varices 10 or 11, low, thin, sharp, slightly reflected, anteriorly smooth, continuing over the suture into which they dip, and making a nearly complete circuit of the spire; base rounded, aperture subovate; there is a slight broadening of the varix at the shoulder of the whorl, but no angulation. Length, 13; diameter, 5 mm. U. S. Nat. Mus. Cat. No. 201203. Range, San Diego to Panama.

EPITONIUM COLUMNELLA, new species.

Shell small, white, with about five whorls exclusive of the (lost) nucleus; the whorls rather rapidly enlarging; varices 11, high, thin, angular and spinose at the shoulder, and distinctly angular at the margin of the base, on which the reflected portion is distinctly flattened, but with no basal disk or cord; base imperforate, aperture rounded, the reflected margin produced at the shoulder and in front. Length, 2.75; diameter, 1.75 mm. U. S. Nat. Mus. Cat. No. 111220. Range, Panama Bay, in about 30 fathoms.

EPITONIUM BERRYI Dall, 1907.

This species has 22 varices without angles or spines and ranges from San Pedro Bay in 200 fathoms to San Diego in about 75 fathoms. It is of the type of the West Indian *E. inconspicuum* Sowerby, 1847, but much smaller.

EPITONIUM HABELI, new species.

Shell small, acute, conical, white, with five rounded whorls exclusive of the (lost) nucleus; varices 16, low, rather thick, not reflected or angular, continuous over the suture and making about half the circuit of the spire; upper whorls delicately spirally striate, the sculpture becoming obsolete on the fourth and entirely absent from the last whorl; base rounded, with a small umbilical perforation; aperture rounded, the reflected margin produced near the axis in front. Length, 7.5; diameter, 4 mm. U. S. Nat. Mus. Cat. No. 56055. Range, Galapagos Islands, collected by Dr. Simon Habel.

This species completely bridges the gap between *Asperiscala* and *Nitidoscala*.

EPITONIUM DIEGENSE, new species.

Shell minute, whitish, with five whorls exclusive of the (defective) nucleus; varices 11 to 12, sharply anteriorly striated, angular at the shoulder, continuous over the suture, and making about half the circuit of the spire; base rounded, imperforate; aperture subovate, the reflected margin angular at the shoulder. Length, 5; diameter, 2 mm. U. S. Nat. Mus. Cat. No. 211904. Range, San Diego to La Paz, in 7 to 10 fathoms.

EPITONIUM TABOGENSE, new species.

Shell small, short, conic, white, with nearly three smooth nuclear and four or five subsequent whorls; varices 11, sharp, erect, not continuous over the suture, not angulated or spinose at the shoulder, anteriorly smooth; base rounded, imperforate; aperture subcircular, the thickened margin nearly interrupted over the body. Length, 3; diameter, 1.5 mm. U. S. Nat. Mus. Cat. No. 211786. Range, Panama Bay, near Taboga Island, in 62 fathoms.

EPITONIUM CATALINAE Dall, 1908.

Shell of moderate size, slender, whitish, with three smooth, brownish nuclear whorls and seven or more subsequent whorls; varices 14 or 15, angular or even subspinose above, tabulating the profile of the spire, below the shoulder flatly greatly expanded, the distal edge often coalescing with the next preceding varix, the base imperforate, aperture rounded. U. S. Nat. Mus. Cat. No. 198628. Range, Catalina Island to San Diego, California.

The varical margins being very thin are usually more or less broken, but a complete and perfect specimen would probably show a large percentage of coalescence nearly covering the later part of the shell proper. This species would be referred by De Boury to the section *Crisposcala*.

EPITONIUM REGUM, new species.

Shell small, whitish, acute, with three smooth nuclear and seven or more subsequent whorls; varices 19 to 20, strongly anteriorly striated, narrowly flatly reflected, continuous over the suture and making about half the circuit of the spire, the anterior faces of the varices slightly irregularly crenulated; they are sharply angulated at the shoulder, giving the profile a turriculate aspect; base rounded, imperforate; aperture rounded, the reflected margin narrow. Length of five whorls, 9; maximum diameter, 4; diameter at decollation, 0.8 mm. U. S. Nat. Mus. Cat. No. 206596. Range, off Point Reyes, in 61 fathoms; off San Diego, in 48 to 78 fathoms.

This species is of the same general type as *E. catalinae*, but has more numerous and less expanded varices, which are obsoletely crenated.

EPITONIUM ORCUTTIANUM, new species.

Shell small, white, acute, with two smooth, short nuclear and six subsequent whorls; varices 10 to 12, narrow, erect, with a narrow reflection and an angle or even a small spine at the shoulder, not continuous over the suture, the anterior surface smooth, the base imperforate. Length, 6.5; diameter, 3 mm. U. S. Nat. Mus. Cat. No. 273998. Range, San Diego Harbor, foot of Broadway, C. R. Orcutt.

EPITONIUM BIALATUM, new species.

Shell stout, short, white, with a flesh-colored peripheral band in the later whorls; two short, smooth nuclear and six subsequent whorls; varices seven or eight, white, solid, erect, with a produced angulation at the shoulder, smooth anteriorly, continuous over the suture and making about half the circuit of the spire; base imperforate, aperture subovate, the reflected margin broad and much produced at the shoulder and in front. Length, 15; diameter, 10 mm. U. S. Nat. Mus. Cat. No. 180798. Range, Gulf of California, near La Paz, in 10 fathoms, and West Mexico.

This is a specially well marked species, perhaps related to *E. statuminatum* Sowerby.

EPITONIUM ZEPHYRIUM, new species.

Shell white, polished, solid, conic, with about five whorls exclusive of the (lost) nucleus; varices, nine, low, continuous, and bridging the suture, encircling about one-third of the spire in ascending to the apex, with smooth interspaces; varices smooth in front and without spines or angulation; base rounded, imperforate, without disk or cord; aperture subovate with narrow margin somewhat expanded in front and at the suture. Length, 11.5; diameter, 6 mm. U. S. Nat. Mus. Cat. No. 56056. Range, San Diego, California.

EPITONIUM BASICUM, new species.

Shell white, with a brownish narrow band in front of the suture when fresh, with seven whorls exclusive of the (lost) nucleus; varices 11, low, rounded, cord-like, continuous over the suture into which they dip, and making nearly half a turn in ascending around the spire, one or two near the terminal are larger than the rest; interspaces smooth; base rounded, marginated by a strong cord, imperforate; aperture subovate, the margin narrow, somewhat patulous in front. Length, 15; diameter, 7 mm. U. S. Nat Mus. Cat. No. 56049. Range, Gulf of California to Panama.

EPITONIUM ROBERTI, new species.

Shell white, solid, rather short, with two smooth nuclear and six subsequent whorls; varices 13, smooth, low, erect, continuous over the suture into which they dip, and encircling about one-fourth of the spire in ascending to the apex; base rounded, imperforate, marginated by a slender not prominent cord; aperture subovate, with a narrow margin, slightly wider on the side of the axis; the varices on the later whorls are without angulation or spines, but on the early whorls a small spine is developed at the shoulder which in subsequent whorls becomes obsolete and finally lost. Length, 12; diameter, 6.5 mm. U. S. Nat. Mus. Cat. No. 46251. Range, Gulf of California, Dr. Robert E. C. Stearns.

EPITONIUM RHYTIDUM, new species.

Shell small, subcylindric, pinkish white, strongly sculptured, of about 10 whorls exclusive of the nucleus which is missing. The type specimen retains six whorls, rounded and with a deep suture; varices 18 or 19, low, rounded, crenate; whorls spirally sculptured with (on the last whorl seven or eight) flattish cords; base flattish, nearly smooth, imperforate, marginated by a strong cord; aperture rounded. Length of decollate type-specimen, 5.5; diameter, 2 mm. U. S. Nat. Mus. Cat. No. 207604. Range, Galapagos Islands, in 40 to 634 fathoms.

This little shell has a remarkable sculpture, recalling some Pyramidellids, none of which, however, have a reflected margin to the lip. It is probable that its habitat is in the shallower water, and the presence of the broken specimen in the deep water adventitious.

It is quite likely that among De Boury's numerous sections there is one (perhaps *Funiscala*) into which this would fit, but not having typical specimens of all of them for comparison I refrain from selecting a sectional name for it.

EPITONIUM ZETEKI, new species.

Shell small, white, thin, with about 8 whorls, the nucleus of about one and a half glassy rounded whorls (with a portion lost?); last whorl with obscure, close-set spiral striae, with no basal disk or cordon; whorls rounded, suture deep; there are 11 sharp, erect, rather low varices, smooth on the front with no spines or angles, descending into the suture and regularly continuous over the spire, which they about half encircle; aperture nearly circular, axis imperforate. Height, 6.0; maximum diameter, 3.0 mm. U. S. Nat. Mus. Cat. No. 324463. Range, Panama, collected by Mr. James Zetek.

This species is nearest to *xantusi* but is more solid, has continuous varices, less emphatic spiral sculpture, and increases more rapidly in diameter. The former has not been found at Panama

EPITONIUM IMBREX, new species.

Shell minute, white, thin, with six or more whorls, the nucleus eroded and the last whorl of the type-specimen incomplete; there is no spiral sculpture, basal disk, or cordon; on the last whorl are about 22 varices, thin, low, smooth, protractive behind at the suture, with a hint of angulation at the periphery and remarkably arcuate on the imperforate base; the varices are continuous, somewhat appressed at the suture, and encircle about one quarter of the spire. Height, 2.3; diameter of last whorl, 1.0 mm. U. S. Nat. Mus. Cat. No. 324464. Range, beach at Panama, James Zetek.

This little species has more varices in proportion to its size than any other thus far reported, and is remarkable for the sigmoid arcuation of the varices.

EPITONIUM THYLAX, new species.

Shell small, white, solid, with 8 sharp-edged solid continuous varices; nucleus conic with three smooth whorls; subsequent whorls seven, feebly spirally striate, needing strong magnification to make it out; varices not descending deeply into the suture, nearly parallel with the axis, without angulation or spines; there is no basal disk or cord, the aperture is ovate, the base imperforate. Height, 6.25; diameter, 2.6 mm. U. S. Nat. Mus. Cat. No. 324465. Range, beach at Panama, James Zetek.

This species except for its spiral striation recalls in miniature such forms as *cookeianum*, *hexagonum*, etc.

The following species are not represented in the collection of the United States National Museum.

SCALARIA ACICULINA Hinds, 1843.

This is a slender purple brown species with about 12 arcuate varices and 10 whorls. It is imperforate and the varices are not spinose at the shoulder. The shell is about 8.5 mm. long and is said to come from the west coast of Central America.

SCALARIA VULPINA Hinds, 1843.

This is about 6 mm. long with about 8 whorls of a reddish brown color, slender, acute, spirally striated, with a strong basal cord, and is said to come from the island of Quibo, Veragua, Central America. The figure suggests a resemblance to *S. retiporosa* Carpenter.

SCALARIA CRASSILABRIS Sowerby, 1847 (not of von Koenen, 1885).

Is probably a Philippine shell wrongly reported from Mazatlan.

SCALARIA GRACILIS Sowerby, 1844.

Was originally described as a Philippine shell, and its reference to the west coast of America is due to a misidentification. It is not *S. gracilis* A. Adams, 1862, nor of H. Adams, 1860, nor Verrill, 1880. It is the type of *Graciliscala* De Boury, 1909.

CIRSOTREMA FUNICULATA Carpenter, 1857 (not of Watson, 1883).

Has two spiral ribs on the base and 15 to 20 varices. It is described from Mazatlan and resembles *S. diadema* Sowerby, 1832, of the Galapagos fauna.

SCALARIA INDISTINCTA Sowerby, 1844.

Has fine spiral sculpture and many simple uniform axial varices. It is reported from San Blas and the Gulf of California.

SCALARIA MITRAEFORMIS Sowerby, 1844.

Was described from Guacomayo, Central America.

SCALARIA SUPRASTRIATA Carpenter, 1857.

From Mazatlan, has the whorls not touching, is imperforate, with acute spire. It has 12 acute varices and a small spine at the shoulder.

SCALARIA OBTUSA Sowerby, 1844.

From Santa Elena, Ecuador; is not the species so named from Panama by C. B. Adams.

SCALARIA REGULARIS Carpenter, 1856.

Has 9 whorls and 10 to 12 sharp varices. There is obsolete spiral sculpture on the early whorls. It is a Panama species.

SCALARIA CUMINGI Carpenter, 1856.

Was also described from Panama. It has 8 or 9 varices.

SCALARIA DIADEMA Sowerby, 1832.

Is a Galapagos species.

SCALARIA RARICOSTATA Carpenter, 1857.

From the Gulf of California; has 8 slender varices. It is *S. carpenteri*, Tapparone Canefri, 1876, not *raricosta* Lamarck, 1822, nor of Costa (1844?). It belongs to *Punctiscala* De Boury, 1890.

SCALARIA REFLEXA Carpenter, 1855.

From San Blas, has 5 varices, with spout-like or subtubular spines. This is referred to *Hirtoscala* Monterosato, 1890, by Cossmann.

SCALARIA STATUMINATA Sowerby, 1844.

Belongs to the general group which includes *Epitonium bialatum*. It was described from Payta, Peru. It is also reported from Panama Bay, near Taboga Island.

SCALARIA POLITA Sowerby, 1844.

Was described from Xipixapi, Ecuador, and is referred to *Longiscala* De Boury, 1910.

SCALARIA ELENENSIS Sowerby, 1844.

Came from Santa Elena, Ecuador.

SCALARIA PRINCIPALIS Pallas, 1774.

Of which *S. costulata* Kiener is a synonym, is reported from West Colombia, which is certainly erroneous. Gmelin states that it is a native of Coromandel, and Cossmann refers it to the Philippines. The west Colombian shell is *ducalis* Mörch, 1876, and was named by Tapparone Canefri *S. simillima* in the same year.

FOSSIL ECHINI OF THE PANAMA CANAL ZONE AND COSTA RICA.

By Robert Tracy Jackson,
Of Peterborough, New Hampshire.

INTRODUCTION.

The fossil echini of the Panama Canal Zone were submitted to me for study and description by Dr. T. Wayland Vaughan as part of the studies he is making in that region in connection with his investigations of the geology of the Coastal Plain of the United States and of the West Indies. The material contains some very interesting species, particularly in the genus *Encope*, of which there are three new forms. Some of the material is well preserved, and parts are fragmentary. A number of specimens too poorly preserved, or too fragmentary for specific determination, indicate that a more extensive echinoid fauna may be found by further search.

I wish to express my heartiest thanks to my friend, Dr. Hubert Lyman Clark, of the Museum of Comparative Zoölogy who, with his great knowledge of Clypeastroids and Spatangoids, helped me materially in preparing this report.

LIST OF SPECIES AND THEIR GEOLOGIC OCCURRENCE.

Clypeaster lanceolatus Cotteau. Oligocene, Emperador limestone Gaillard Cut, stations 5866*b*, 6671.

Clypeaster gatuni, new species. Upper Oligocene[1] Gatun formation, station 5662, near Gatun Dam site; and at station 6237, north of Ancon Hill, about 4 miles south of Diablo ridge.

Encope annectans, new species. Upper Oligocene,[1] Gatun formation, station 5846, Spillway, Gatun Dam.

Encope platytata, new species. Upper Oligocene,[1] Gatun formation, station 6029*a*, one-quarter to one-half mile from Camp Cotton, toward Monte Lirio.

Encope megatrema, new species. Upper Oligocene,[1] Gatun formation, station 6030, about one and one-half miles from Camp Cotton, toward Monte Lirio.

Echinolampas semiorbis Guppy. Oligocene, Emperador limestone, Gaillard Cut, stations 5866*b* and 6019G.

[1] This formation perhaps may more appropriately be referable to the lower Miocene, i. e., Burdigalian. For a recent discussion of the geologic age of the members of the Apalachicola group in Florida and Georgia, see Vaughan, T. W., The reef-coral fauna of Carrizo creek, Imperial County, California, and its significance: U. S. Geol. Survey, Prof. Pap. 98-T., pp. 363-366, 1917—T. W. V.

Schizaster armiger W. B. Clark. Eocene, Bonilla, Costa Rica.

Schizaster cristatus, new species. Upper Oligocene,[1] Brazil, Costa Rica, station 5505.

Schizaster panamensis, new species. Upper Oligocene,[1] Gatun formation, near Gatun, at stations 6008 and 7294.

DESCRIPTION OF THE SPECIES.

CLYPEASTER LANCEOLATUS Cotteau.

Plate 62, figs. 1, 2.

Clypeaster lanceolatus COTTEAU, Descripcion de los Equinoides Fossiles de la Isla de Cuba. Bol. Com. del. Mapa Geologico de Espana, vol. 22, 1897, p. 39, pl. 9, figs. 1, 2, 3.

This species is one of the few in the series from the Panama Canal Zone that seems referable to an already published species. There are seven specimens, all in good condition of preservation and representing two localities which, however, from the character of the material may be nearly associated. I give measurements of the largest specimen of the set. Length, 95 mm.; width, 77 mm.; height, 21 mm. Test elongate, wider behind than in front, moderately elevated, deeply concave in ventral view. Ambulacral petals elevated, distally acuminate, nearly closed and pinched up as if squeezed between the thumb and finger. Anterior petal III equal in length to petals I and V and a few millimeters longer than are the anterior pair II and IV. The anterior petal III is more widely separated from petals II and IV than are those latter from I and V. Interporiferous areas of petals are elevated, wide, being about equal to both poriferous areas. Interambulacra are narrow, extremely so near the apical disk. Tubercles are small and of about the same size dorsally and ventrally. Apical disk is central, mouth central, deeply sunken, periproct ventral, about four mm. from the posterior border of the test. The original material described by Cotteau is from the "Miocene" of Matanzas, Cuba, where he says it is very rare. It is apparently more or less common in the Canal Zone, as there are seven specimens from that region.

Localities and geologic occurrence.—Oligocene; Emperador limestone. Upper Limestone, Las Cascadas, Panama, D. F. MacDonald, collector, U. S. National Museum station No. 6671, two specimens, U. S. Nat. Mus. Cat. No. 324452; also Panama Canal Zone, upper Limestone bed, near Tower "N" (opposite Las Cascadas, Gaillard Cut) D. F. MacDonald, collector, 1911, U. S. National Museum station No. 5866–*b*, five specimens, U. S. Nat. Mus. Cat. No. 324451.

[1] This formation perhaps may more appropriately be referable to the lower Miocene, i. e., Burdigalian. For a recent discussion of the geologic age of the members of the Apalachicola group in Florida and Georgia, see Vaughan, T. W., The reef-coral fauna of Carrizo creek, Imperial County, California, and its significance: U. S. Geol. Survey, Prof. Pap. 98-T., pp. 363-366, 1917—T. W. V.

CLYPEASTER GATUNI, new species.

Plate 63, fig. 1, plate 64, fig. 1.

This species is represented by a fine, large specimen in perfect condition of preservation. Two additional specimens much worn and incomplete are also referred to it.

The type measures 146 mm. in length, 122 mm. in width, and 35 mm. in height. The test is elongate, moderately pentagonal in outline, with slight incurving of the borders in interambulacral areas 1, 2, 3, and 4. Its greatest width is across ambulacra II and IV. Ventrally the test is deeply concave, being flat only on the border. The ambulacral petal III is equal in length to petals I and V and a few millimeters longer than are petals II and IV. The petals are equidistant, highly elevated, and open at their distal ends. Ventrally, five deep ambulacral grooves extend to the mouth. Interambulacra are broad on the border of the test, narrowing up dorsally and very narrow near the apical disk. Each of the interambulacra between the petals are strongly elevated as if pinched up. The apical disk is slightly anterior to the middle of the test and is very small. The mouth is central, deeply sunken. The periproct is ventral, slightly elliptical, its posterior border 5 mm. from the posterior limits of the test. Tubercles are small, covering the dorsal surface of the test, ventrally the same, but slightly larger.

Clypeaster gatuni approaches nearest, perhaps, to *C. bowersi* Weaver, but differs in the shape of the test, the deeply concave base, the shape and proportionate size of the petals and interambulacra dorsally, and the fact that the periproct is ventral instead of terminal.

Locality and geologic occurrence.—Gatun formation, upper Oligocene or Miocene. Panama Canal Zone, near Gatun Dam site, D. F. MacDonald, collector, 1911, holotype, U. S. National Museum, station No. 5662, one specimen.

Limestone in swamp, north of Ancon Hill, about 4 miles south of Diablo Ridge in the Emperador limestone, U. S. National Museum, station No. 6237, two specimens.

Holotype.—Cat. No. 324453, U.S.N.M.

This species is present on both the Atlantic and Pacific sides of the Isthmus.

ENCOPE ANNECTANS, new species.

Plate 65, figs. 1, 2; plate 66, fig. 1.

This interesting new species is represented by three specimens which include two tests free from matrix and more or less complete, and a sandstone mold of the exterior of the ventral side of a specimen which is the largest of the three.

In shape, the specimens are thin, flattened, and nearly circular in outline, excepting for the reëntrant marginal ambulacral notches.

The edges are thin, exceptionally so for the genus, and the whole test superficially is scutelliform. In the anterior ambulacrum III there is a shallow rounded notch, and in the lateral ambulacra are deeper and narrower notches, the deepest being in the posterior pair of ambulacra, IV and V. The apical disk is central. The peristome is small and also central. Continuing posteriorly from the peristome on the ventral side is a quite deep groove, and on the dorsal side is a shorter and shallower groove. These grooves do not form

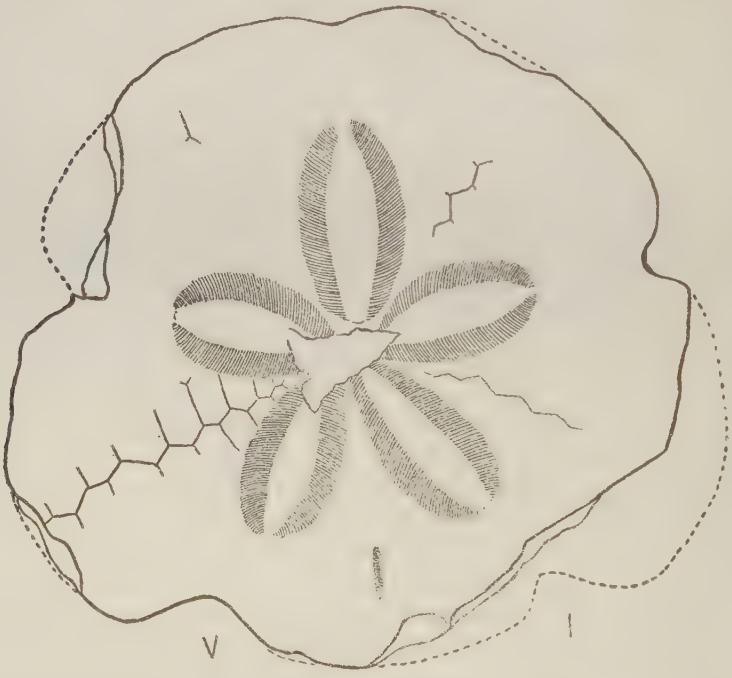


FIG. 1.—ENCOPE ANNECTANS. DRAWING OF THE TYPE-SPECIMEN, NATURAL SIZE. RESTORED PARTS ARE INDICATED BY DOTTED LINES.

a hole through the test, but represent the incipient beginnings of the lunule which is characteristic in Encope of the posterior interambulacrum 5. This is most interesting and is discussed later at length.

The type-specimen measures 86 mm. in length, 89 mm. in width, and 8 mm. in height. The highest point is distinctly anterior to the middle of the test. The specimen represented by a mold of the ventral side is somewhat larger than the type. It measures about 93 mm. in length by about 96 mm. in width.

In the type, the ambulacral petals are broad, about equal in length in the several areas, the posterior pair extending back to a line with the anterior limit of the lunule in interambulacrum 5. Ventrally, the ambulacral furrows are deep, slightly curved outward from the

median line of each ambulacrum, forking near the border of the test, each furrow giving off a forked branch at nearly a right angle to the main furrow. The apical disk is central, but details are obscured owing to local imperfections in both specimens showing the dorsal side. Interambulacral areas are narrow in the petaloid areas, wide near the margin of the test. The whole dorsal surface of the test is covered with small tubercles; on the ventral side of the test the tubercles are somewhat larger, but they are reduced in size or wanting along the lines of the ambulacral furrows. The mouth is small and central in position. The periproct is small, oval in outline, and situated at nearly one-third the distance from the mouth to posterior border of the test.

The lunule of interambulacrum 5 is the remarkable and most interesting feature of this species. Ventrally, it consists of an impressed area 15 mm. long by 2 mm. wide, extending to and being confluent with the opening of the periproct. Dorsally, the lunule also consists of an impressed area lying above the middle of the ventral lunular depression and measuring 10 mm. in length by 2 mm. in width. This is the only species in the genus recorded in which the lunule fails to make an opening through the test. Structurally, it is most interesting, as it closely resembles the condition in a young specimen of *Mellita sexiesperforata* (Leske) from the west coast of Florida, 30 fathoms, No. 2900, Museum of Comparative Zoölogy. This young Mellita, which measures 9 mm., in length has no notches or lunules as yet developed in the ambulacral areas, but in interambulacrum 5, as viewed ventrally, there is a distinct impressed area marking the initial beginnings of a lunule as in our specimen of adult *Encope annectans*. It should be stated that this specimen of Mellita is probably exceptional in holding this youthful character so late, as in a small series of younger specimens of *M. sexiesperforata* measuring from 4 to 7 mm. in length, all have a perforate lunule in interambulacrum 5. This latter set is from Salt Key, Bahamas, No. 2439, Museum of Comparative Zoölogy. As pointed out by Mr. Agassiz (Revision of the Echini, pp. 320–324) in *Mellita sexiesperforata*, the ambulacral and interambulacral lunules develop by resorption through the test, whereas in the other species of Mellita, as far as known, the ambulacral lunules are developed by the inclusion of marginal notches and the interambulacral lunule alone is formed by invagination through the test.

Encope annectans is primitive like the other fossil species of Encope in that the ambulacral notches are not inclosed to form lunules but are still shallow and open. It is undoubtedly the most primitive of the genus in that the lunule in interambulacrum 5 is still imperforate. It makes an approach to the Recent *Encope michelini* Agassiz

of the Gulf of Mexico and *E. grandis* Agassiz of the Gulf of California which are the only living species characterized by open marginal notches. On the other hand, *E. annectans* resembles *Encope micropora* Agassiz of the West Coast in the form of the test and the position of the interambulacral lunule.

Locality and geologic occurrence.—Gatun formation, upper Oligocene or Miocene, Panama Canal Zone, Spillway at Gatun Dam site, D. F. MacDonald, collector, U. S. National Museum station No. 5846, three specimens.

Type.—Cat. No. 324454, U.S.N.M. *Paratype.*—Cat. No. 324466, U.S.N.M.

ENCOPE PLATYTATA, new species.

Plate 67, figs. 1, 2.

There is only a single specimen representing this species, and while it is imperfect, it yet has the essential parts preserved that are necessary for a description. As in the last described species, *E. annectans*, this species, *E. platytata*, is thin, flattened, and if complete, apparently would be nearly circular in outline excepting for the ambulacral notches. If complete, the specimen would measure as estimated about 100 mm. in length and 100 mm. in width. The greatest height of the test is in the apical region, where it measures 10 mm. As the ventral side of the test is somewhat concave instead of being flat, the thickness of the test at the center, as measured by calipers, is somewhat less than the height and measures only 8 mm.

The anterior ambulacral notch of area III is very shallow and rounded. The notches of the lateral anterior ambulacra II and IV are also rounded but deeper than the notch of area III. Presumably the notches of the posterior ambulacra I and V, if preserved, would be similar but somewhat deeper, as this is the usual character in associated species. The lunule in interambulacrum 5 is small, but passes directly through the test instead of being imperforate as in *Encope annectans*. This lunule is only preserved for the anterior part of its extent as shown in the figures. The mouth is small and central in position, the periproct is elongate oval, its anterior border is 13 mm. posterior to the border of the mouth opening. Posteriorly the periproct is confluent with the infolded depression of the interambulacral lunule.

The ambulacral petals are rather narrow in this specimen, measuring 13 mm. in width. The odd anterior ambulacral petal is longer than the others, and measures 36 mm. in length, whereas the posterior petals of the trivium measure 28 mm. in length. The petals of the bivium, or I and V, are longer than the posterior pair of the trivium, but as they are incomplete posteriorly, a measurement can not be given. On the ventral side, the ambulacral furrows are strongly marked and each gives off a few weakly impressed branches.

The apical disk is quite well preserved, shows clearly the ocular pores and four of the five genital pores, which are a characteristic feature of Encope. The only genital wanting is that occurring in area 1, which is destroyed by a local fracture of the test. Minute tubercles cover the dorsal side of the test. Ventrally the tubercles are larger except near the ambulacral furrows where they are minute.

Encope platytata is a near ally of *Encope tenuis* Kew [1] of the Miocene of California, but differs from that species in that the greatest height of the test is central, and the periproct is confluent with the lunule.

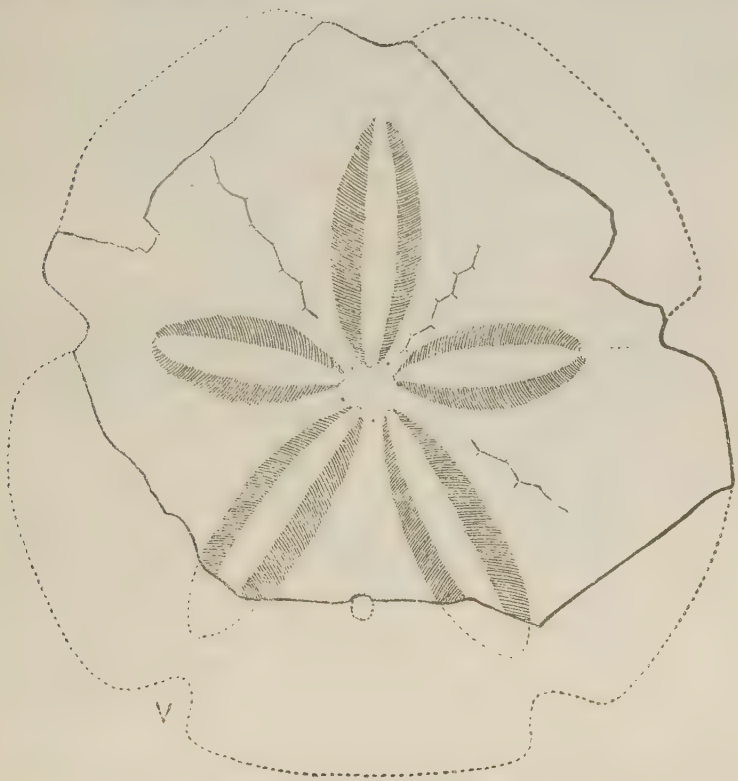


FIG. 2.—ENCOPE PLATYTATA. DRAWING OF THE TYPE-SPECIMEN, NATURAL SIZE. RESTORATIONS ARE INDICATED BY DOTTED LINES.

Locality and geologic occurrence.—Gatun formation, upper Oligocene or Miocene, Panama Canal Zone, from lowest horizon in big cut, one-fourth to one-half mile beyond Camp Cotton toward Monte Lirio, D. F. MacDonald and T. W. Vaughan, collectors, 1911, U. S. National Museum station No. 6029*a*, one specimen.

Type.—Cat. No. 324455, U.S.N.M.

[1] Kew, W. S. W. Tertiary echinoids of the Carrizo Creek Region in the Colorado Desert. University of California Bull., Dept. Geology, vol. 8, no. 5, pp. 39–60, pls. 1–3, 1914.

ENCOPE MEGATREMA, new species.

Plate 68, fig. 1.

This species is represented by one fairly good test with its counterpart, and in addition some 12 fragments which yield helpful facts on close study. From the incompleteness, measurements and some details will have to be given in general terms or omitted. As a whole,

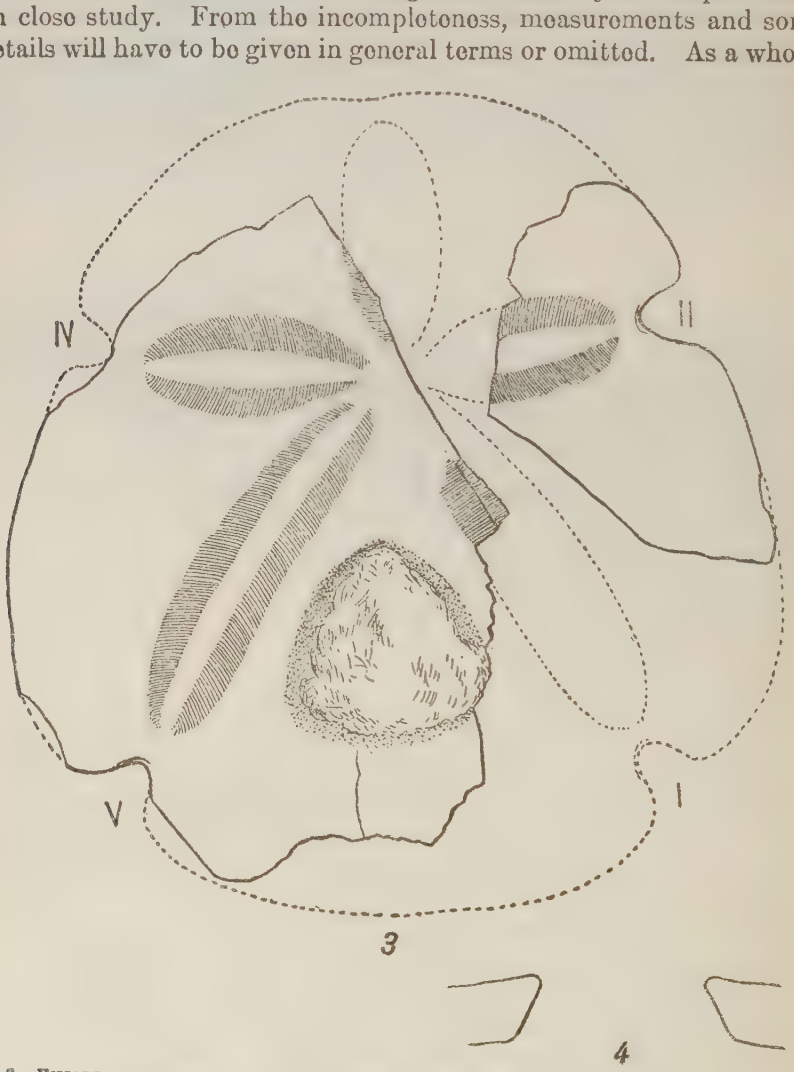


FIG. 3.—ENCOPE MEGATREMA. HOLOTYPE, NATURAL SIZE. THE AREA SHOWING PART OF AMBULACRUM II IS DRAWN FROM A FRAGMENT. RESTORATIONS INDICATED BY DOTTED LINES.
FIG. 4.—SECTION OF LUNULE TO SHOW INCLINED FACES, DRAWN FROM TWO FRAGMENTS.

the test is low, elongated, thin on the borders and with shallow ambulacral notches and an enormous lunule in interambulacrum 5.

From the best specimen, which is figured, the length probably was about 120 mm. and the width about 106 mm.; thickness of the test at its center is 10 mm. Ambulacral notches are shallow and quite

wide in areas II and V, indicating that this is the character in the two posterior ambulacra I and V and also in the paired anterior ambulacra II and IV. This evidence is supported by several of the fragments which show shallow lobes like the type, but it can not be definitely stated which areas they represent. The notch of the anterior odd ambulacrum III is not known, but it was probably shallower than the others, as is characteristic of species of the genus. The most striking feature of this species is the lunule in interambulacrum 5, which is enormous. It is situated about midway between the apical disk and posterior limits of the test, is roughly triangular in shape, the apex of the triangle pointing anteriorly. It measures at the surface of the opening 27 mm. in length and 27 mm. in width at the widest part posteriorly. The walls of the lunule slope outward from the center, as seen looking from above, as is well shown in two of the fragmentary specimens. From this sloping character of the walls, it results that the width of the lunule would be greater by about 6 to 10 millimeters on the ventral side than it is on the dorsal. The height of the wall of the lunule is 12 mm., which is doubtless the highest point of the test. The lunule in this species is, relatively to the size of the specimens, the largest known in any species of the genus, fossil or living. It is striking that this great size of the lunule, a progressive character, should be associated with small and shallow ambulacral notches which, for the genus, is a relatively primitive character.

The ambulacral petals are beautifully distinct and well preserved for part of their extent in the type and one other specimen. The posterior pair, I and V, are long and narrow with a relatively wide poriferous area and narrow median interporiferous area. The width of the petal of ambulacrum V is 11 mm. and its length is 50 mm. It extends posteriorly in a wide curve around the lunule of interambulacrum 5 and reaches a line coincident with the posterior end of the lunule. It also extends to within 5.5 of the ambulacral notch of the area in which it lies. Ambulacrum IV is much shorter than ambulacrum V, measuring 30 mm. in length and 12 mm. in width at its widest part. This ambulacrum extends to within 3.5 mm. of its marginal notch. The features of the ambulacra V and IV as described indicate the character of ambulacra I and II, which are only preserved in part in the holotype, though one of the fragments has ambulacrum II quite perfectly preserved. Ambulacrum III is represented only in part (for a length of 25 mm.) by the left side of its petaloid area; it probably had about the length and width of the petal of ambulacrum IV, as in the allied species *Encope macrophora* Ravenel. Ambulacral furrows on the ventral side are deep, strongly marked with some forking near the periphery of the test. The interambulacra are very wide, not narrowing markedly near the apical disk. Minute tubercles

cover the dorsal surface of the test, and ventrally the tubercles are larger excepting on the lines of ambulacral furrows, where they are minute or wanting. Details of the apical disk, peristome and periproct are entirely wanting. This species does not make a close approach to any other known species, but its nearest ally is *Encope macrophora* Ravenel from the upper Miocene of South Carolina and the Pliocene of Florida.[1]

Locality and geologic occurrence.—Gatun formation, upper Oligocene or Miocene, Panama Canal Zone. From 85-foot cut north side of big swamp on relocated line, Panama R. R., about one and one-half to two miles beyond Camp Cotton towards Monte Lirio, D. F. MacDonald and T. W. Vaughan, collectors, 1911. Fourteen specimens, including fragments, U. S. National Museum station No. 6030.

Type.—Cat. No. 324456, U.S.N.M.

ECHINOLAMPAS SEMIORBIS Guppy.

Echinolampas semiorbis GUPPY, On Tertiary Echinoderms from the West Indies. Quart. Journ. Geol. Soc. London, vol. 22, 1866, p. 299, pl. 19, fig. 7.—COTTEAU, Echinides Tertiares des Iles St. Barthélemy et Anguilla. Kongl. Svensk. Vetenskaps. Akad, vol. 13, 1875, p. 24, pl. 5, figs. 1–2; pl. 6, fig. 1.

This species is abundant in the Oligocene Tertiary of the West Indies, material from Anguilla having been described by Guppy, and Cotteau erroneously records it from St. Bartholomew. Dr. T. Wayland Vaughan in 1914 collected abundant, fine specimens in the Island of Anguilla.

From the Panama Canal Zone a number of specimens were collected from a hard gray limestone. The specimens are for the most part uncompressed and in very good condition of preservation. One of the largest specimens measures 107 mm. in length, 103 mm. in width, and 53 mm. in height.

Locality and geologic occurrence.—Oligocene. Emperador limestone, Panama Canal Zone. Upper Limestone bed near Tower "N" (opposite Las Cascadas, Gaillard cut), D. F. MacDonald, collector, 1911, U. S. National Museum station No. 5866*b*, one specimen, U. S. Nat. Mus. Cat. No. 324457. Also Panama Canal Zone, from 5th or topmost limestone, Gaillard cut, opposite Las Cascadas, U. S. National Museum station No. 6019G, D. F. MacDonald and T. W. Vaughan, collectors, 1911, 4 specimens. U. S. Nat. Mus., Cat. No. 324458.

SCHIZASTER ARMIGER W. B. Clark.

Schizaster armiger CLARK and TWITCHELL, Mesozoic and Cenozoic Echinodermata of the United States. Monograph U. S. Geol. Survey, vol. 54, 1915, p. 152, pl. 70, figs. 1*a–d*.

In this species the test is rather large, cordiform; upper surface slopes at first rapidly, then more slowly from the anterior margin to

[1] Clark, William Bullock, and Twitchell, Mayville W. Mesozoic and Cenozoic Echinodermata of the United States. Monograph, U. S. Geol. Survey, vol. 54, 1915, p. 206, pl. 93. figs. 2*a–e*; pl. 94, figs. 1*a–f*.

the apical system beyond which an elevated sharp ridge continues to the truncated posterior margin. Length, 59 mm.; width, 50 mm.; height, 25 mm. The ambulacra are broad and the odd anterior ambulacral petal III is situated in a deep groove that indents the anterior margin. The two lateral anterior ambulacra II and IV are in deep, broad grooves, with petals 18 mm. long. The posterior ambulacra I and V, similar but shorter, are 9 mm. long. Peripetalous fasciole is broad and distinct. Interambulacra gibbous, the posterior No. 5 being built up into an elevated keel. The peristome is indistinct in our specimen, but as shown in W. B. Clark's excellent figures, is wide and near the anterior margin. The periproct is high on the truncated posterior end.

The type material described by Clark is ascribed to the upper (Jackson) Eocene of Choctaw County, Alabama.

Locality and geologic occurrence.—Eocene, Bonilla, Costa Rica, Hill collection, U. S. Nat. Mus. Cat. No. 135214, one specimen.

SCHIZASTER CRISTATUS, new species.

Plate 68, figs. 2–4.

The material of this species consists of two internal moulds; as the plates are entirely wanting, of course external characters can not be given. The more perfect of the two specimens measures 40 mm. in length, 36 mm. in width, and 22 mm. in height. Test is moderate sized, cordiform, sloping gradually from the anterior border up to the median crest, the widest portion being through the middle of the test. The most striking feature of this species is the median keel-like crest that rises sharply from the summit of interambulacrum 5 at the posterior border of the test.

The petal of ambulacrum III is sunken in a deep, wide groove, extending to the anterior border of the test and measuring 23 mm. in length. The petals of the lateral anterior ambulacra II and IV are in deep grooves measuring 13 mm. in length and having about 22 plates in each half ambulacrum, as is indicated by the casts of the pores. The petals of the posterior ambulacra I and V are widely divergent from the anterior pair, nearly parallel and directed backward in deep, sunken grooves. The grooves are 7 mm. long, and there are about 14 plates in each half ambulacrum at this point, as indicated by casts of the pores. The periproct is situated on the posterior face and coincides with the base of the crest in interambulacrum 5. The peristome is wide and situated far forward, the tip which almost closes the mouth being 10 mm. from the anterior border of the test.

Locality and geologic occurrence.—Upper Oligocene or Miocene, Brazil, Costa Rica, A. Alfaro, collector, U. S. National Museum station No. 5505, two specimens.

Type.—Cat. No. 324460, U.S.N.M.

SCHIZASTER PANAMENSIS, new species.

Plate 66, figs. 2–3.

The material consists of an internal mould free from matrix, and three specimens more or less complete, embedded in porous, dark-colored volcanic tuff which also bears some fragments of lignite. The specimen, free from matrix, is the most completely preserved, although somewhat compressed dorso-ventrally, and is selected as the type. The specimen measures 48 mm. in length, 40 mm. in width, and 25 mm. in height. The petals of the ambulacra are situated in broad, deep furrows. The anterior petal III extends to the anterior limit of the test and measures 23 mm. in length. The paired anterior ambulacra II and IV are in grooves 13 mm. long and diverge widely from the anterior petal. The posterior petals I and V are shorter than the anterior pair, measuring 5 mm. in length, and are directed almost straight backward. The position of the periproct is not clearly indicated on the mould, but apparently it is near the upper part of the posterior face. The peristome is wide and rounded, and is situated 16 mm. from the anterior border of the test. The peripetalous fasciole is quite wide and is fairly well shown in areas II and IV on the type-specimen and still better in one of the fragments, which is a counterpart of the dorsal side of the same.

One of the specimens, which is an external mould, shows the impress of the outline of the plates of part of a test, and gives measurements of considerable interest. It measures about 50 mm. in length, about 45 mm. in width, and about 38 mm. in height. From incompleteness of the specimen no exact measurements can be given, yet those available indicate a very high test.

Locality and geologic occurrence.—Gatun formation, upper Oligocene or Miocene, Panama Canal Zone. Second cut, south of Gatun R. R. Station, Goldman Coll., U. S. National Museum station No. 7294, four specimens. Holotype, U. S. Nat. Mus. Cat. No. 324461. Another specimen, imperfect and much worn, with a very high test, and apparently referable to this species, is from Panama Canal Zone, Gatun, section A, from middle of Bed "E," D. F. MacDonald, collector, U. S. National Museum station No. 6008, one specimen. U. S. Nat. Mus. Cat. No. 324462.

DESCRIPTION OF PLATES.

Plate 62.

Fig. 1. *Clypeaster lanceolatus* Cotteau, dorsal view, natural size. The dark spot in interambulacrum 5 is a yellow label that took black in the photograph. U. S. Nat. Mus., Cat. No. 324451, Station 5866*b*.

2. Another specimen of the same, ventral view, natural size, U. S. Nat. Mus., Cat. No. 324451, Station 5866*b*.

Plate 63.

Fig. 1. *Clypeaster gatuni*, new species, dorsal view. Holotype, slightly reduced, U. S. Nat. Mus., Cat. No. 324453, Station 5662.

PLATE 64.

FIG. 1. *Clypeaster gatuni*, new species, ventral view; same specimen as Plate 63. Holotype, slightly reduced, U. S. Nat. Mus., Cat. No. 324453, Station 5662.

PLATE 65.

FIG. 1. *Encope annectans*, new species, dorsal view, natural size. Holotype, U. S. Nat. Mus., Cat. No. 324454, Station 5846.

2. The same, ventral view.

PLATE 66.

FIG. 1. *Encope annectans*, new species. Another specimen, external mould of ventral side seen from above. Natural size, Paratype, U. S. Nat. Mus., Cat. No. 324466, Station 5846.

2. *Schizaster panamensis*, new species. Dorsal view, natural size. Holotype, U. S. Nat. Mus., Cat. No. 324461, Station 7294.

3. The same, ventral view. The dark spot in interambulacrum 5 is a yellow ticket that took black in the photograph.

PLATE 67.

FIG. 1. *Encope platytata*, new species. Dorsal view, natural size. Holotype, U. S. Nat. Mus., Cat. No. 324455, Station 6029*a*.

2. The same, ventral view. The dark spot in interambulacrum 4 of fig. 1 and in interambulacrum 2 of fig. 2 are yellow tickets that took black in the photographs.

PLATE 68.

FIG. 1. *Encope megatrema*, new species. Dorsal view, natural size. Holotype, natural size, U. S. Nat. Mus., Cat. No. 324456, Station 6030.

2. *Schizaster cristatus*, new species. Dorsal view, natural size. Holotype, U. S. Nat. Mus., Cat. No. 324460, Station 5505.

3. The same, ventral view.

4. The same, side view.

1

2

DORSAL (1) AND VENTRAL VIEWS (2) OF CLYPEASTER LANCEOLATUS.

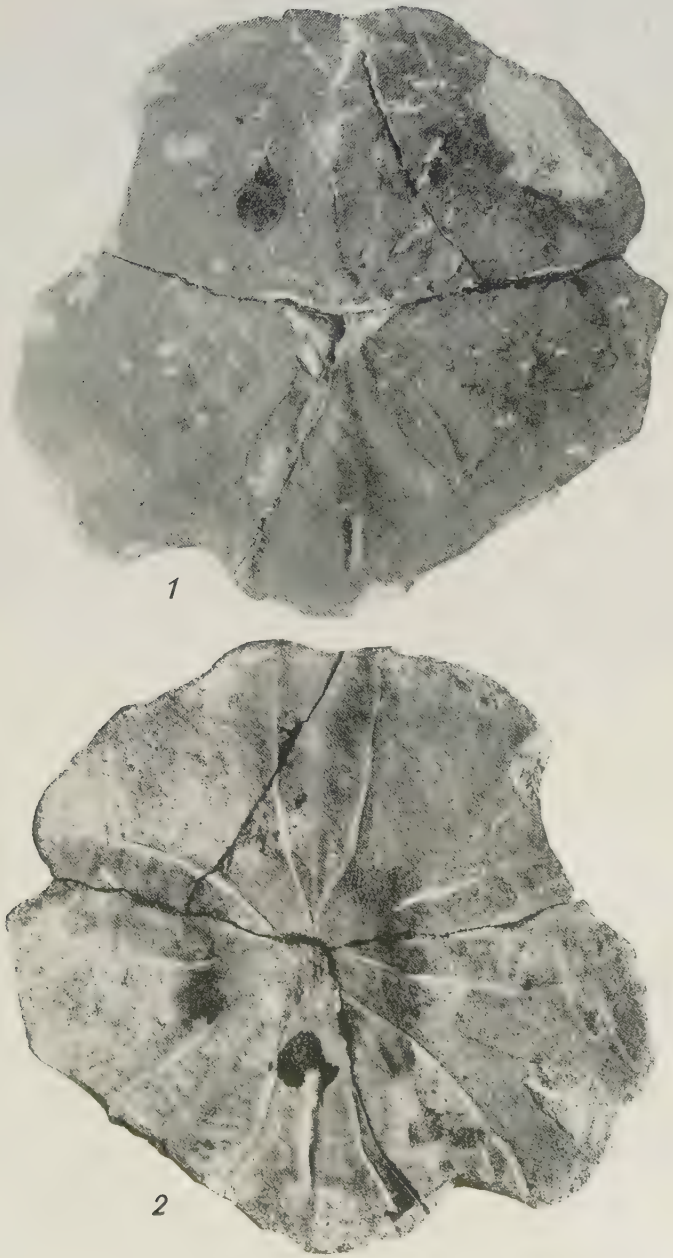
FOR EXPLANATION OF PLATE SEE PAGE 500.

DORSAL VIEW OF CLYPEASTER GATUNI.

FOR EXPLANATION OF PLATE SEE PAGE 500

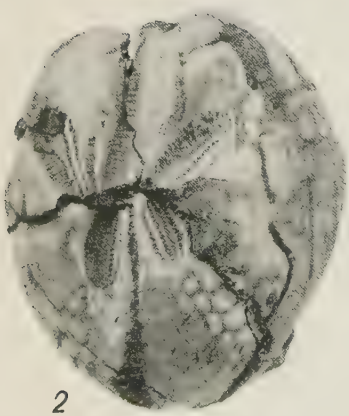
VENTRAL VIEW OF CLYPEASTER GATUNI.

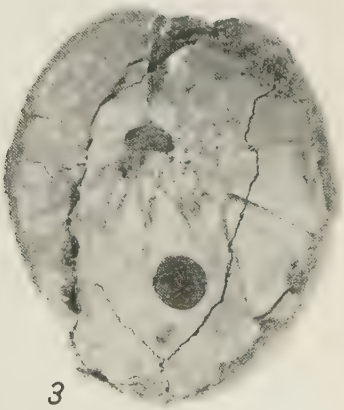
FOR EXPLANATION OF PLATE SEE PAGE 501.



DORSAL (1) AND VENTRAL VIEWS (2) OF ENCOPE ANNECTANS.

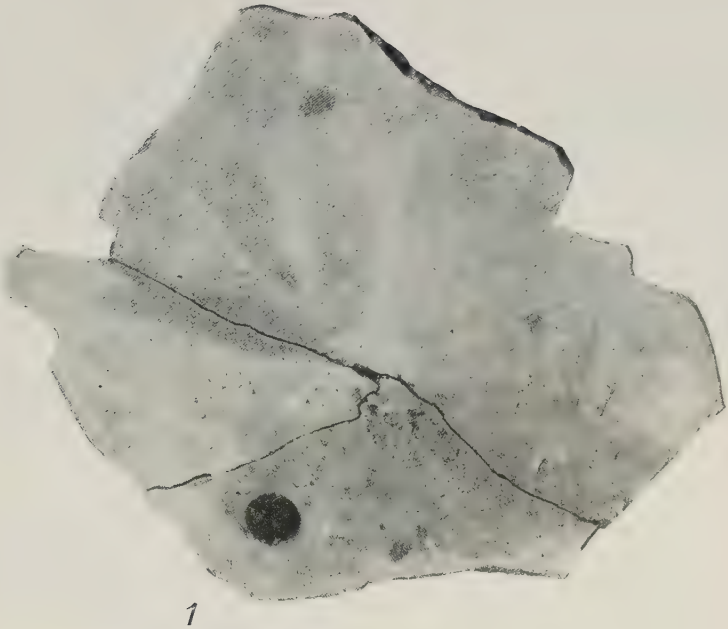
FOR EXPLANATION OF PLATE SEE PAGE 501.





1. Mould of Ventral Side of Encope annectans seen from above, (2) Dorsal, and (3) Ventral Views of Schizaster panamensis.

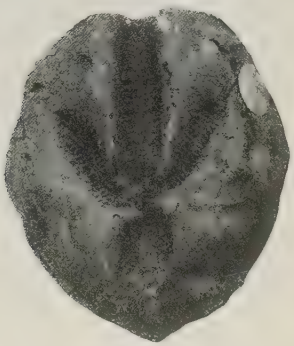
For explanation of plate see page 501.



DORSAL VIEW (1) AND VENTRAL VIEW (2) OF ENCOPE PLATYTATA.

FOR EXPLANATION OF PLATE SEE PAGE 501.

1



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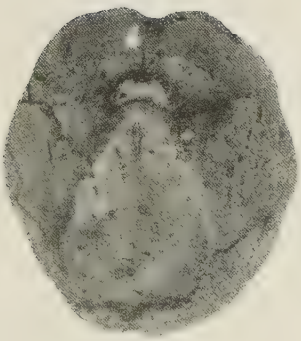

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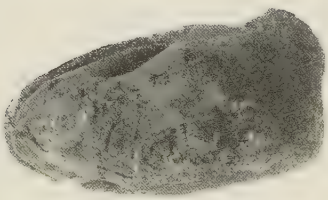

4

1. Dorsal View of Encope megatrema. Dorsal (2), Ventral (3), and Side (4) Views of Schizaster cristatus.

For explanation of plate see page 501.

A REVISION OF HYMENOPTEROUS INSECTS OF THE TRIBE CREMASTINI OF AMERICA NORTH OF MEXICO.

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As defined by Ashmead, the tribe Cremastini is distinguished from the Porizonini by the obsolescence in the latter tribe of the base of the middle vein in the hind wing and by the thickening of the anterior end of the basal vein in the front wing. Aside from the question as to whether these characters, as interpreted by Foerster, who proposed them, are good or not, the fact remains that the genotype of *Cremastus* has the middle vein obliterated at the base, and by no means all of the genera at present referred to the Porizonini exhibit the thickening of the basal vein. Foerster [1] made use, also, of the angulation of the radial abscissae, ascribing to the Porizonini a right angle and to the Cremastini an obtuse angle. The strict interpretation of this character separates species much more closely allied to each other and to *Cremastus* as represented by the genotype, than either is to *Porizon* as represented by the genotype.

The relation between the length and breadth of the stigma as used by Foerster to separate his Cremastoidae from the families which follow it in his arrangement can not be used, since several species of *Cremastus* have the stigma distinctly less than half as wide as long. Also the occipital carina varies in Cremastini from widely interrupted above to complete.

The genera of these two tribes, however, form two rather well-defined groups, separated by propodeal, abdominal, and venational characters, as indicated in the following tabulation:

Propodeum not extending beyond base of hind coxae; abdomen usually short and stout, not or but weakly compressed, the second tergite not very much longer than wide, most frequently transverse, and with the sides widely divergent; angle of radius right or acute, touching or very close to cubitus, the intercubitus being very short and not or but very little longer than that portion of cubitus between it and recurrent, most frequently shorter, all veins at this point being nearly interstitial; ovipositor most frequently short and upcurved.....*Porizonini.*

[1] Verh. Nat. Ver. Preuss. Rheinl., vol. 25, 1868, p. 141.

Propodeum extending beyond base of hind coxae; abdomen long and slender, strongly compressed beyond second tergite, the latter very much longer (two to six times) than wide and with its sides subparallel or weakly divergent; angle of radius right or obtuse, far removed from cubitus, the intercubitus much longer than that portion of cubitus between it and recurrent, the latter occasionally interstitial; ovipositor most frequently long and straight..... *Cremastini.*

None of the species available for study agree in all particulars with any of the genera proposed by Szepligeti, nor with *Celor*, Semenow, although a number of the species of *Cremastus* might with propriety be referred to certain of these genera.

Demophorus Thomson seems not to occur in the North American fauna. It should be remarked, however, that certain species allied to the genotype of *Zaleptopygus* Viereck, here considered a subgenus of *Cremastus*, have the upper portion of the intercubitus slightly thickened and angulate, and occasionally a wing is found in which the second intercubitus is represented by a stump of a vein arising from this angle.

One new genus is described below for the reception of Cresson's *Porizon stigmaterus*.

KEY TO NORTH AMERICAN GENERA OF CREMASTINI.

Thorax very long and slender, nearly cylindrical; propodeum with areola very long and petiolar area very short, areola usually much longer than petiolar area; thorax and head clothed with a very dense, short, pubescence, which gives a silky lustre; stigma narrow, radius arising far beyond the middle; radial cell very long and narrow, its lower angle very broadly obtuse; second abscissa of radius curving gradually outward, then shargly forward; eyes slightly convergent towards the narrow, strongly convex clypeus; spiracle of first tergite at or not far beyond middle; orbits immaculate except for an obscure brownish mark at level of antennae....*Pseuderipternus* Viereck.

Thorax not subcylindrical, much stouter in front or short and thick; petiolar area seldom shorter than areola, usually much longer; thorax and head with different vestiture; stigma, if narrow, with radius arising at about middle; eyes parallel or slightly divergent toward clypeus; spiracle of first tergite far beyond middle; orbits more or less distinctly pale marked or the head is entirely pale.....1.

1. Palpi very long, the maxillary palpi reaching to middle coxae; abdomen weakly compressed.....*Dolichoselephus* Ashmead.

Palpi normal; abdomen usually strongly compressed.....2.

2. Head small, scarcely as wide as thorax; eyes large, parallel within; face much narrower than eye is long; malar space very short; lateral ocelli distant from the eyes by much less than their own diameter; stigma very broad, the radius originating in the middle, its first abscissa strongly curved; nervulus antefurcal (male unknown) .....*Neocremastus*, new genus.

Head at least as wide as thorax, face broad, malar space not especially short; lateral ocelli distant from the eyes by at least their own diameter (in some males the eyes and ocelli are very large, the malar space, the ocell-ocular line, and the width of the face being much reduced); stigma various, if broad, with the radius usually arising beyond the middle, first radial abscissa not strongly curved, nervulus interstitial or postfurcal, very rarely distinctly antefurcal..... *Cremastus* Gravenhorst.

Genus PSEUDERIPTERNUS Viereck.

Pseuderipternus VIERECK, Conn. State Geol. and Nat. Hist. Survey Bull. 22, p. 269.

Genotype.—Podogaster radiolata Provancher (Monobasic).

Since its description in Podogaster, the genotype has been placed in *Limnerium* by Cresson,[1] who considered *Podogaster* a synonym of *Limnerium;* in *Eripternus* by Ashmead,[2] under the manuscript name *primus* Ashmead; in the last genus by Viereck,[3] where he used it as a basis for comparison of his genus *Eripternimorpha* with *Eripternus;* and more recently Viereck has erected for it the present genus, which he treats as a subgenus of *Casinaria*, a Campoplegine genus.

To the present writer the placing of the genus in the Campoplegini seems entirely erroneous. In Cresson's synopsis it runs to *Cremastus* Gravenhorst by virtue of its separated clypeus, a character in which it differs markedly from the Campoplegini. Its completely areolated propodeum is also out of place in the latter tribe. In Szepligeti's key to the genus [4] it runs to *Pseudocremastus* Szepligeti. From Cremastus and from *Dolichoselephus* Ashmead it differs principally in the characters used in the above table to genera, the most striking of which are the nearly middle position of the spiracles of the first abdominal segment, the great length of the areola, the very narrow stigma accompanied by the distally originating radius, and the long, narrow, very obtusely angled radial cell.

From *Dolichoselephus* it also differs in having the palpi normal.

From the description of *Pseudocremastus* it differs principally in the very low propodeum.

From *Eripternus* (Foerster) Szepligeti it differs by the characters used by Szepligeti in his group synopsis and by nearly all the characters in his generic description of *Eripternus.*

Head st ongly transverse, roundly narrowed posteriorly, occipital carina broadly interrupted in middle, eyes slightly convergent below face convex, clypeus narrow and strongly convex, clypeal foveae deep, malar space very short, ocelli in both sexes small, antennae long, filiform, the flagellar joints gradually decreasing in length from base to apex where they are nearly as wide as long, palpi normal, thorax long, subcylindrical, nearly straight above, notauli very weak, propodeum elongate, low, prolonged about one-third length of coxae, completely areolated, even the posterior abscissa of lateral carina being more or less distinctly present, areola occupying half or more of the length and the petiolar area very short, spiracle nearer to lateral than to pleural carina; front wings with stigma and radial cell elongate, the former with the radius arising far beyond middle, hind wings with median vein obliterated basally, nervellus

[1] Synop. Hym., 1887, p. 204.
[2] Smith's Ins. New Jersey, 1899.
[3] Proc. U. S. Nat. Mus., vol. 44, 1913, p. 645.
[4] Gen. Ins., fasc. 34, 1905, p. 49

distinctly broken at or somewhat below middle and postfurcal; first tergite with the spiracle at or but slightly beyond the middle, petiole rather thick and deeply sulcate laterally, ventral edges of tergite widely separated and subparallel, tergites beyond second strongly compressed; head and thorax very finely punctate and clothed with very short, dense, silky pubescence.

KEY TO NORTH AMERICAN SPECIES.

Petiolar area nearly as long as areola; first and second tergites tipped with red, the postpetiole strongly longitudinally rugulose; second tergite much less than twice as long as basal width, its sides widely divergent; second abscissa of radius nearly straight at base; ovipositor less than twice as long as first tergite ..... *brevicauda*, new species.

Petiolar area a third or less as long as areola; first and second tergites entirely black; the postpetiole at most weakly aciculate; second tergite about twice as long as basal width with sides nearly parallel; second abscissa of radius distinctly outcurved at base; ovipositor about three times as long as first tergite ..... 1.

1. Malar space much less than half as long as basal width of mandible in female, sometimes half as long in male; hind legs stout, femur nearly one-third as broad as long, basitarsus much less than half as long as tibia, all tarsal joints together in female about as long as tibia, in male slightly longer *radiolatus* (Provancher).

Malar space about as long as basal width of mandibles in female, longer in male; hind legs slender, femur hardly one-fourth as broad as long, basitarsus nearly half as long as tibia, all tarsal joints together in both sexes much longer than tibia ..... *gracilipes*, new species.

PSEUDERIPTERNUS BREVICAUDA, new species.

Female.—Length 7 mm., antennae 5.5 mm., ovipositor 1.6 mm. Head, except occiput, very finely, densely granular; face elevated in middle, weakly impressed below antennae, with prominent, median tubercle above; malar space scarcely a third as long as basal width of mandible; interfoveal line (shortest distance between clypeal foveae) twice as long as foveo-ocular line (shortest distance between fovea and eye); eyes very weakly emarginate opposite antennae; postocellar and ocell-ocular lines equal and scarcely twice as long as diameter of a lateral ocellus. Thorax very minutely punctate, mesonotum subpolished; mesopleural suture broadly foveolate; propodeal carinae very strong, the areola scarcely a half longer than petiolar area, apical areas strongly rugulose; wing with radial cell rather acute at apex, base of second discoidal cell scarcely half as long as second recurrent vein; nervellus interstitial, broken at middle; legs, especially hind legs, short, the hind femur about a third as broad as long; hind basitarsus about two-fifths as long as tibia, fifth joint nearly as long as third. Abdomen barely a third longer than head and thorax united; first tergite rather stout, its sides nearly straight, about half as wide at apex as long, its spiracle distinctly beyond middle, carinae and foveae of petiole very strong; second tergite

scarcely twice as long as wide at base, distinctly wider at apex, it and the postpetiole longitudinally rugulose; ovipositor about a half longer than first tergite.

Black; a small spot between insertion of antenna and eye brown; clypeus at apex, mandibles, palpi, and legs (largely) rufo-testaceous; antennae black, paler below; hind trochanters, last tarsal joints, and apices of hind tibiae (faintly) infuscated; tergites, 1 to 5, black at base, reddish at apex, third largely reddish, remaining tergites black.

Male.—Very like female, but with eyes scarcely divergent, malar space slightly wider, ocelli slightly larger, and black color of tergites more extensive.

Type-locality.—Hanover, New Hampshire.

Other locality.—Canada.

Type.—Cat. No. 20251, U.S.N.M.

Described from one female and one male, the former captured by C. M. Weed and the latter by C. F. Baker.

Distinct from the other two species in its short ovipositor, short areola, short second tergite, and abdominal coloration.

PSEUDERIPTERNUS GRACILIPES, new species.

Female.—Length 10 mm., antennae 7.5 mm., ovipositor 5 mm. Head finely, densely granular; face scarcely elevated in middle, more evenly convex throughout, with minute median tubercle above; malar space about half as long as basal width of mandible; interfoveal line twice as long as foveo-ocular line; inner line of eye concave for most of its length; postocellar and ocell-ocular lines equal and about a half longer than diameter of a lateral ocellus. Thorax densely, minutely punctured, mesonotum subpolished; mesopleural suture sharp, foveolate only at its upper extremity; propodeal carinae strong, the areola more than three times as long as petiolar area, all areas granularly punctuate, petiolar with a few short longitudinal rugae apically; wings with radial cell obtusely pointed, base of second discoidal cell about two-thirds as long as second recurrent vein, nervellus slightly postfurcal and broken slightly below middle; hind legs slender, the femur hardly one-fourth as wide as long; hind basitarsus nearly half as long as tibia, fifth joint nearly as long as third. Abdomen one-third longer than head and thorax united, sculpture granular, subpolished toward apex, postpetiole weakly aciculate; first tergite about two-fifths as wide at apex as long, sides of petiole concavely and of postpetiole convexly arcuate, spiracle at middle, carinae and foveae of petiole strong; second tergite about two and one-half times as long as wide at base, its sides nearly parallel; ovipositor about three times as long as first tergite.

Black; a small spot between antenna and eye brown; mouth parts, antennae, and legs colored as in *brevicauda* except a little darker

throughout, especially the hind tibia and all tarsi; tergites 1 and 2 black throughout, 3 largely reddish, 4 and 5 reddish with median black spot, 6 reddish with black apical spot, others black.

Male.—Very like female, but with eyes nearly parallel within, malar space considerably longer, tergites slightly narrower, and hind tibiae darker.

Type-locality.—Massachusetts.

Other locality.—Camden, New Jersey.

Type.—Cat. No. 20252, U.S.N.M.

Very closely allied to *radiolatus* Provancher, the principal distinguishing characters being those given in the table to species. Apparently these characters are quite variable and the two species may prove to be the same when a larger series of specimens is available for study. The species seems to average slightly larger than *radiolatus*.

Described from two females and two males, the paratype female from Cape May, New Jersey, and all others from Massachusetts. The paratypes differ from the types principally in having the reddish color of the abdomen largely replaced by blackish.

PSEUDERIPTERNUS RADIOLATUS (Provancher).

Podogaster radiolata PROVANCHER, Nat. Can., vol. 7, 1875, p. 329, female.

In the United States National Museum collection is a female specimen from Long Island, designated as a homotype by Mr. A. B. Gahan, who compared it with the type of *Podogaster radiolata* Provancher. In addition to the characters given in the table to species, this differs from the type of *gracilipes* in having the eyes slightly more convergent; the diameter of the ocelli only about half as long as postocellar line; the postpetiole relatively somewhat longer and the petiole shorter, the second tergite wider, the hind tibiae black with their tarsi by contrast paler. In a number of males from New Hampshire, Massachusetts, and Connecticut there is considerable variation with respect especially to the length of the malar space, from about as long as in the female to about half as long as basal width of mandible, in the relative length of hind tibiae and tarsi, and in the stoutness of the hind femora. The color is the same and varies in the same way as in *gracilipes*.

Genus DOLICHOSELEPHUS Ashmead.

Dolichoselephus ASHMEAD, Bull. 1, Colo. Biol. Soc., 1890, p. 23.

Szepligeti [1] considers this genus a synonym of *Heterocola* Foerster. Such may be the case, but since the unique specimen of the genotype (*Dolichoselephus cockerelli* Ashmead) differs from Szepligeti's description of *Heterocola* in possessing well-marked lateral fovea on the

[1] Gen. Ins., fasc. 34, 1905, p. 56.

petiole and the compression of the abdomen is not especially conspicuous, it seems hardly advisable to synonymize the two genera without a comparison of the genotypes. This is not possible at this time.

The great length of the palpi renders this genus easily separable from *Cremastus*, although this character is really the only positive one that has been discovered.

The propodeum extends but a short distance over the coxae, and is completely areolated. The ventral edges of the first tergite are widely separated and not at all inclosing the sternite. The second tergite is about twice as long as wide with sides weakly divergent, and the abdomen as a whole moderately long and rather weakly compressed. The hind legs are rather long and stout. The difference in length between the transverse cubitus and the second abscissa of the cubitus is rather less, and the basal vein rather more strongly incurved than is usually the case in *Cremastus*.

Genus NEOCREMASTUS, new genus.

Genotype.—(*Porizon*) *Neocremastus stigmaterus* Cresson.

Allied to *Cremastus* Gravenhorst from which it differs principally in head characters. Head in front view nearly circular, small, scarcely as wide as thorax; eyes large, parallel within; face much narrower than eye is long; malar space very short; lateral ocelli distant from the eyes by much less than their own diameter; propodeum not extending to middle of hind coxae, carinae rather weak; stigma very broad, the radius originating in the middle, its first abscissa strongly curved, radial cell very short; nervulus antefurcal; first tergite with its ventral margins parallel, not inclosing the sternite; abdomen strongly compressed beyond second tergite.

NEOCREMASTUS STIGMATERUS (Cresson).

Porizon stigmaterus CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 174.

This species is represented in the United States National Museum by a paratype female minus the abdomen and another female from the Belfrage collection minus the ovipositor.

Genus CREMASTUS Gravenhorst.

Cremastus GRAVENHORST, Ichn. Eur., vol. 3, 1829, p. 730.= *Temelucha* FOERSTER, Verh. Nat. Ver. Preuss. Rheinl., vol. 25, 1868, p. 148=*Zaleptopygus* VIERECK, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 294.

As here defined, *Cremastus* is, in the general appearance of its species, rather heterogeneous. It embraces, in addition to the more typical forms, Viereck's genus *Zaleptopygus*, as well as species, which with a little more liberal interpretation of characters might be referred to Szepligeti's genera *Paracremastus* and *Pseudocremastus*. These are, however, not separable except on comparative or widely variable

characters, and there is apparently ground for doubt as to the validity of Szepligeti's two genera above mentioned. At least the characters used are of very doubtful generic value. *C. rostratus*, new species, and *C. longigenalis*, new species, display the characters peculiar to *Paracremastus* Szepligeti but to a less marked degree, while several species placed toward the end of the key to species run in Szepligeti's table and agree fairly well with the description of *Pseudocremastus* Szepligeti. But the characters which ally them with those genera prove, upon examination of a large series of species, to be subject to great variation.

Temelucha plutellae Ashmead, the genotype of *Temelucha* Foerster is conspecific with a specimen in the United States National Museum determined by Schmiedeknecht as *Cremastus decoratus* Gravenhorst, which all European authorities concede to be a true *Cremastus*. The genotype, *Cremastus spectator* Gravenhorst, I have not seen.

Zaleptopygus, erected by Viereck for his species *obereae* and *Porizon orbitalis* Cresson, is really not at all closely related to *Leptopygus* Foerster. The propodeum, in which Viereck says it is more closely allied to the latter genus than to *Cremastus*, differs essentially from that of a typical *Cremastus* only in being more robust, shorter, and in having the areola and petiolar area separated by a carina. In *Leptopygus*, as represented by the genotype, *L. harpurus* (Gravenhorst) the basal transverse carina and the basal portion of the lateral carina are obsolete, while that portion of the lateral carina that separates the apical lateral and apical pleural areas is strong. In *Cremastus* the opposite is true.

The principal characters which distinguish this genus from *Pseuderipternus* Viereck are indicated in the table to genera, and the more striking ones designated in the discussion of the latter genus. The only character separating it from *Dolichoselephus* Ashmead is found in the normal palpi as distinguished from the abnormally long palpi of the latter genus. It is easily distinguished from *Neocremastus* Cushman by the characters used in the generic key.

In secondary sexual characters the males of some species differ very little from the females, while others exhibit very striking modifications. The eyes and ocelli in some species are but little larger in the male than in the female, while in others the eyes occupy the whole sides of the head and the ocelli occupy nearly the entire vertex. The postpetiole in most males is more depressed than in the females, and the petiolar carinae and foveae are stronger, being sometimes present in the male when absent in the female.

In using the key for the determination of species no character in a group should be given precedence over any other, but a majority of characters should be considered as indicating the way in which

the species should be run. In the first dichotomy, for example, agreement with two of the three characters allies a species with a group indicated thereby. These groups of characters, rather than single characters, are used in the table because, by their use, the species arrange themselves in a manner more in accord with their apparent natural affinities.

The extent of secondary sexual modification is so variable in the males that it seems inadvisable to attempt, in most cases, to associate the sexes in the material at hand. This can, with assurance of correctness, be done only by biological observations, either in regard to mating or by rearing the sexes at the same time and from the same host. On this account and because a number of species have been described only in the male, the two sexes are tabulated separately.

KEY TO NORTH AMERICAN SPECIES (FEMALES).

Petiole with ventral margins of tergite approximating below and nearly enclosing sternite, never parallel; propodeum reaching to or beyond middle of dorsal surface of hind coxae; stigma narrow with radius originating at or near the middle (subgenus *Cremastus* Gravenhorst)..... 1.

Petiole with the ventral margins of tergite widely separated, parallel or nearly, not enclosing sternite; propodeum not reaching to middle of dorsal surface of hind coxae; stigma broad and with radius originating beyond middle (subgenus *Zaleptopygus* Viereck)..... 19.

1. Head subrostriform; malar space much longer than basal width of mandible. *longigenalis*, new species.

Head not subrostriform; malar space rarely as long as basal width of mandible, most frequently much shorter..... 2.

2. Thorax testaceous or yellow, sometimes more or less black dorsally or ventrally..... 3.

Thorax black, sometimes with yellow markings dorsally or laterally..... 14.

3. Eyes distinctly, though slightly, divergent below..... 4.

Eyes parallel within..... 8.

4. Second tergite nearly six times as long as wide, at base; malar space as long as basal width of mandible; ovipositor sheath scarcely longer than first tergite. *longiventris*, new species.

Second tergite distinctly less than six times as long as basal width; malar space usually less than basal width of mandible, occasionally subequal; ovipositor sheath much longer than first tergite..... 5.

5. Scutellum with strong lateral carinae extending nearly or quite to apex; head in front view subtriangular..... 6.

Scutellum with carinae developed only at base; head in front view suboval.. 7.

6. Clypeus little more than half as long as interfoveal line (shortest distance between clypeal foveae) and subacutely rounded at apex; malar space subequal to basal width of mandible; spiracles of second tergite distinctly before middle; areola and petiolar area separated by a strong carina. *ruficeps*, new species.

Clypeus about three-fourths as long as interfoveal line, evenly strongly rounded at apex; malar space distinctly less than basal width of mandible; spiracles of second tergite in middle; carina separating areola and petiolar area subobsolete..... *gracilis*, new species.

7. Head mostly ferruginous with black markings on vertex and occiput broadly confluent; face and clypeus in profile strongly convex, clypeal suture deep, clypeus with apex depressed.....*gracilipes*, new species.

Head mostly yellow with black markings on vertex and occiput not confluent, that of occiput obsolescent; face and clypeus in profile weakly convex, clypeal suture shallow, clypeus with apex prominent....*ferrugineus* Davis.

8. Dorso-lateral carinae of first tergite entirely obsolete..... 9.

Dorso-lateral carinae of first tergite present at least for a distance in front of the spiracles..... 10.

9. Thorax rather stout, propodeum barely reaching middle of coxae; stigma broad with radius originating slightly beyond middle; head except black ocellar spot and brownish occiput, yellow; malar space nearly as long as basal width of mandible.....*flaviceps*, new species.

Thorax slender, propodeum reaching distinctly beyond middle of coxae; stigma narrow with radius originating at middle; head with yellow, if present, confined to orbits; malar space distinctly shorter than basal width of mandible.....*graciliventris*, new species.

10. First tergite not or scarcely longer than dorsal length of propodeum..... 11.

First tergite distincly longer than propodeum..... 12.

11. Clypeus compressed from the sides, inflexed and broadly rounded at apex; scutellum strongly convex; propodeum black, at least in basal middle; second tergite not striate, shagreened; small, 7 mm. or less.... *minor*, new species.

Clypeus nearly convex, not compressed from the sides, apex sharply rounded and not inflexed; scutellum somewhat flattened; propodeum not marked with black; second tergite striate; large, 10 mm..... *brevipetiolus*, new species.

12. Lateral carinae of scutellum strong to apex; clypeal suture arched slightly above level of foveae; malar space as long as basal width of mandible.

platynotae, new species.

Lateral carinae of scutellum weak toward apex; clypeal suture not arched above level of foveae; malar space shorter than basal width of mandible..... 13.

13. Eyes distinctly longer than width of face; compressed portion of abdomen scarcely three times as long as deep, the third tergite much less deep than fourth.

facilis (Cresson).

Eyes not longer than width of face; compressed portion of abdomen slightly more than three times as long as deep, the fourth tergite scarcely deeper than the third..... *tortricidis*, new species.

14. All coxae black at least basally..... 15.

Coxae pale, at most the posterior pair black at base..... 17.

15. Thorax with notauli and scutellum yellow, pleura more or less yellowish; orbital ring broad and complete; ovipositor about twice as long as first tergite.

decoratus Gravenhorst.

Thorax entirely black; orbital ring narrow and incomplete..... 16.

16. Front coxae only white at apex; postpetiole not elevated above level of petiole, scarcely twice as wide as petiole; ovipositor but little longer than first tergite.

brevicauda, new species.

All coxae white at apex; postpetiole elevated above level of petiole, twice as wide as petiole; ovipositor one and one-half times as long as first tergite; tergites beyond second more or less yellow at apex and below.

evetriae, new species.

17. Stigma fully half as wide as long; dorso-lateral carinae of petiole entirely obsolete; wings milky hyaline with veins except stigma and costa very pale.

cookii Weed.

Stigma barely one-third as wide as long; dorso-lateral carinae of petiole distinct; wings clear hyaline with dark veins..... 18.

18. Compressed portion of abdomen distinctly more than three times as long as deep, third tergite nearly as deep as fourth; diameter of posterior ocelli as long as ocell-ocular line and much more than half as long as postocellar line; portion of propodeum beyond insertion of coxae, viewed from above, deeply, concavely emarginate laterally, the posterior lateral angle nearly right.
forbesii Weed.

Compressed portion of abdomen barely three times as long as deep, third tergite distinctly less deep than fourth; diameter of posterior ocelli distinctly shorter than ocell-ocular line and barely more than half as long as postocellar line; portion of propodeum beyond insertion of coxae shallowly concave, the posterior lateral angle obtuse ..... *epagoges*, new species.

19. Head subrostriform; malar space much longer than basal width of mandible.
rostratus, new species.

Head not subrostriform; malar space rarely as long as basal width of mandible, most frequently shorter ..... 20.

20. All coxae pale, the hind pair not at all black or blackish at base ..... 21.

At least the hind coxae black or blackish at base ..... 26.

21. Prothorax much paler than surrounding areas ..... 22.

Prothorax concolorous with surrounding areas ..... 25.

22. Mesoscutum entirely black ..... 23.

Mesoscutum with notauli or lateral lobes differently colored ..... 24.

23. Scutellum black; clypeus very weakly rounded at apex, nearly truncate; interfoveal line but little greater than foveo-ocular line (shortest distance from fovea to eye) ..... *cleridivorus*, new species.

Scutellum red; clypeus strongly rounded apically; interfoveal line nearly twice as long as foveo-ocular line ..... *similis*, new species.

24. Thorax laterally largely black or blackish ..... *plesius*, new species.

Thorax laterally largely red ..... *rosae*, new species.

25. Ovipositor sheath little more than twice as long as first tergite; malar space much shorter than basal width of mandible; eyes large, much longer than width of face ..... *tetralophae*, new species.

Ovipositor sheath nearly four times as long as first tergite; malar space subequal to basal width of mandible; eyes smaller, not much longer than width of face ..... *terebratus*, new species.

26. Small species (6 mm. or less) with abdomen black throughout, sometimes obscurely reddish in middle ..... 27.

Large species (7 mm. or more) with first two tergites (occasionally only first one) black, the others red or piceous, sometimes more or less yellow or black or both ..... 28.

27. Face fully a third wider than length of eye; eyes strongly divergent below; clypeus and mandibles piceous, the former very weakly separated, rather narrow, and much more than half as long as wide; ocelli scarcely half as wide as ocell-ocular line; temples broad, strongly rounded.
mordellistenae, new species.

Face scarcely wider than eye length; eyes scarcely divergent; clypeus and mandibles yellow, the former distinctly separated and scarcely half as long as broad; ocelli nearly as wide as ocell-ocular line; temples narrow, flattened; orbital ring interrupted at top of eye with a large triangular spot in the interruption which nearly reaches the lateral ocellus.
incompletus (Provancher).

28. Scutellum strongly convex, without lateral carinae or ridges; tergites beyond third strongly compressed ..... 29.

Scutellum carinate or ridged laterally and usually flattened; tergites not strongly compressed ..... 30.

29. Propodeum extending beyond middle of coxae; first tergite with ventral edges parallel, not enclosing sternite; orbits broadly yellow; second tergite nearly six times as long as basal width, nearly parallel-sided; tergites beyond second bright red ..... *rohweri*, new species.

Propodeum not extending to middle of coxae; first tergite with ventral edges approximating below and nearly enclosing sternite; orbits narrowly yellow; second tergite only about four times as long as basal width, much wider at apex; tergites beyond second piceous ..... *anomalus*, new species.

30. Wings very dark; first two tergites black, others red with ventral and apical margins yellow; ovipositor twice as long as first tergite; petiolar area twice as long as areola, carinae strong; mandibles stout; eyes divergent below, face distinctly wider than length of eye ..... *fuscipennis* (Cresson).

Wings hyaline or faintly dusky ..... 31.

31. Clypeus much more than half as long as interfoveal line, strongly rounded at apex ..... 32.

Clypeus not or but little more than half as long as interfoveal line, very weakly rounded at apex ..... 34.

32. Face and clypeus entirely black, the latter long, strongly convex, densely punctate; petiole without carinae or foveae; antennae short, hardly longer than head and thorax together ..... *nigriclypealis*, new species.

Face at sides and clypeus yellow, the latter broad, weakly convex, weakly punctate, polished; petiole with strong carinae and deep foveae; antennae much longer than head and thorax together ..... 33.

33. All legs slender; natauli and scutellum marked with yellow; ovipositor as long as abdomen ..... *bilineatus*, new species.

Legs stout, especially hind femora; notauli not marked; ovipositor scarcely half as long as abdomen ..... *hyalinipennis* (Cresson).

34. Tergites beyond second contrastingly colored with black, red, and whitish; orbits narrowly yellow, broadly interrupted below and above antennae, not swollen above antennae ..... *gallaecola*, new species.

Tergites beyond second entirely red; orbits broadly yellow, complete except for brief interruption opposite ocelli, swollen above antennae ..... 35.

35. Scutellum with lateral carinae weak except at base, narrowly rounded at apex; areola much shorter than petiolar area, broadly pentagonal; wings hyaline; postpetiole strongly swollen above level of petiole; cheeks behind mandibles very strongly rounded ..... *orbitalis* (Cresson).

Scutellum with lateral carinae strong to apex, nearly quadrate; areola nearly as long as petiolar area, elongate pentagonal; wings slightly dusky; postpetiole hardly swollen above level of petiole, cheeks not especially strongly rounded. *obereae* (Viereck).

MALES.

Petiole with ventral margins of tergite approximating below and nearly enclosing sternite, never parallel; propodeum reaching to or beyond middle of dorsal surface of hind coxae; stigma narrow with radius originating at or near the middle (subgenus *Cremastus* Gravenhorst) ..... 1.

Petiole with ventral margins of tergite widely separated, parallel or nearly, not enclosing sternite; propodeum not reaching to middle of dorsal surface of hind coxae; stigma broad and with radius originating beyond middle (subgenus *Zaleptopygus* Viereck) ..... 9.

1. Thorax testaceous or yellow, sometimes more or less black dorsally or ventrally. 2.

Thorax black, sometimes with yellow markings dorsally or laterally ..... 6.

2. Eyes and ocelli small, neither ocell-ocular line nor malar space especially reduced in length ..... 3.

Eyes and ocelli very large, both ocell-ocular line and malar space very much reduced in length ..... 4.

3. Diameter of lateral ocellus longer than ocell-ocular line; malar space shorter than basal width of mandible; ocellar and occipital black spots much reduced; thorax largely pale yellow, the mesoscutum and propodeum marked with brown.....*flaviceps*, new species.
   Diameter of lateral ocellus shorter than ocell-ocular line; malar space as long as basal width of mandible; ocellar and occipital black spots broadly confluent, the former extending to base of antennae; thorax testaceous with black markings above.....*platynotae*, new species.
4. Diameter of posterior ocellus distinctly shorter than postocellar line; areola and petiolar area distinctly separated.....*minor*, new species.
   Diameter of posterior ocellus equal to or greater than postocellar line, at least not distinctly shorter; areola and petiolar area confluent or only indistinctly separated..... 5.
5. Diameter of posterior ocellus equal to postocellar line; petiole subequal in length to dorsal length of propodeum.....*facilis* (Cresson).
   Diameter of posterior ocellus greater than postocellar line; petiole distinctly shorter than dorsal length of propodeum.....*brevipetiolus*, new species.
6. Hind and middle coxae throughout and front coxae broadly black; orbital ring very narrow behind the eyes and broadly interrupted above and below; face black medially, this mark confluent with the black of malar space. *brevicauda*, new species.
   Hind and middle coxae at most black at base, front coxae entirely yellow; orbital ring broad and complete or at most narrowly interrupted behind the eye; face entirely yellow or if marked with black the malar space is yellow.... 7.
7. Stigma nearly half as wide as long; wings milky hyaline with veins except stigma and costa very pale.....*cookii* Weed.
   Stigma barely one-third as wide as long; wings clear hyaline with dark veins.. 8.
8. Eyes and ocelli not large, former hardly longer than width of face, latter subequal to ocell-ocular line; malar space subequal to basal width of mandible; pronotum and mesoscutum laterally yellow marked...*epagoges*, new species.
   Eyes and ocelli very large, former much longer than width of face, latter much broader than length of ocell-ocular line; malar space very short; pronotum and mesoscutum black except a small, obscurely brownish spot in front of tegula.....*forbesii* Weed.
9. All coxae pale, the hind pair not at all black or blackish at base..... 10.
   At least the hind coxae black or blackish at base..... 12.
10. Eyes and ocelli not especially large, malar space and ocell-ocular line not especially reduced, face broad.....*tetralophae*, new species.
    Eyes and ocelli very large, malar space and ocell-ocular line much reduced, face narrow..... 11.
11. Thorax and propodeum, especially the latter more or less black...*retiniae* Cresson.
    Thorax and propodeum entirely testaceous.....*delicatus* (Cresson).
12. Small species with abdomen black throughout or obscurely reddish in middle, tergites never apically yellow..... 13.
    Larger species with first two tergites (occasionally only first one) black, the others red or piceous, sometimes more or less yellow or black or both, occasionally almost entirely black but with apical tergites narrowly yellowish.. 14
13. Clypeus rather narrow, much more than half as long as wide, and weakly separated from face; posterior ocellus narrower than ocell-ocular line; tergites 3 and 4 piceous or reddish; orbital ring with a broad interruption opposite ocelli, the yellow color not touching the lateral ocellus..*mordellistenae*, new species.
    Clypeus broad, distinctly less than half as long as wide, and with suture deeply impressed; posterior ocellus fully as wide as ocell-ocular line; all tergites entirely black; orbital ring extended triangularly and touching the lateral ocellus, interrupted on each side of the triangular spot. *incompletus* (Provancher).

14. Wings very dark; lateral ocellus about twice as great in diameter as length of ocell-ocular line.....*audax* (Cresson).
Wings hyaline or very faintly dusky; ocelli distinctly either larger or smaller.. 15
15. Clypeus much more than half as long as interfoveal line, strongly rounded at apex; diameter of lateral ocellus scarcely as long as ocell-ocular line..... 16
Clypeus not or but little more than half as long as interfoveal line, very weakly rounded at apex..... 18
16. Wings clear hyaline, venation strong; notauli and scutellum marked with yellow.....*bilineatus*, new species.
Wings milky hyaline; notauli and scutellum black..... 17
17. Venation, except stigma, very pale; clypeus and face convex; eyes deeply convex; temples flattened, sloping; vertex abruptly sloping backward from ocelli, not elevated above ocelli; petiolar area little longer than areola.
viereckl (Cockerell).
Venation dark; clypeus and face flat; eyes shallowly convex; temples strongly rounded; vertex behind ocelli elevated above ocelli; petiolar area nearly twice as long as areola.....*hyalinipennis* (Cresson).
18. Tergites beyond second varied with black, red, and yellow, occasionally almost entirely black, with only the third reddish and the apical ones narrowly tipped with yellow; orbits narrowly yellow, broadly interrupted below and above antennae, not swollen above antennae; diameter of lateral ocellus shorter than ocell-ocular line.....*gallaecola*, new species.
Tergites beyond second entirely red; orbits broadly yellow, complete except for brief interruption opposite ocelli, swollen above antennae..... 19
19. Eyes and ocelli very large, former much longer than width of face and parallel within, malar space and ocell-ocular line very short.....*orbitalis* (Cresson).
Eyes and ocelli small, former about as long as width of face and divergent below, malar space and ocell-ocular line long.....*obereae* (Viereck).

CREMASTUS (CREMASTUS) LONGIGENALIS, new species.

Female.—Length 10 mm., antennae 6 mm., ovipositor 1.7 mm. Head in front view subtriangular, the malar space distinctly longer than basal width of mandible, clypeus long and subacutely rounded at apex, the suture weak; face longitudinally elevated in middle, finely and densely punctate, slightly wider than greatest eye-length; temples nearly flat; occipital carina broadly interrupted above; postocellar line distinctly longer than ocell-ocular line and nearly twice as long as diameter of a lateral ocellus. Thorax, especially propodeum long, the latter gradually sloping from base to apex and reaching distinctly beyond middle of hind coxae; pronotum laterally polished above, irregularly rugulose below; mesoscutum and scutellum finely opaquely punctate, notauli deep and more strongly sculptured, broadening posteriorly; prescutum prominent; mesopleura with longitudinal impression transversely rugulose, the area above polished and that below finely punctate, as are also the sternum and metapleura; propodeum with areola and petiolar area not separated, all dorsal and lateral areas except basal areas transversely rugulose, basal and pleural areas punctate; legs slender, hind basitarsus about three-fifths as long as tibia and about as long as next three tarsal joints together; stigma less than half as wide as long, radius originat-

ing very slightly behind middle; angle of radius very widely obtuse, second abscissa sinuate. Abdomen very slender, slightly more than twice as long as head and thorax united; petiole cylindrical, without carinae or foveae, ventral margins of tergite meeting below and inclosing sternite; postpetiole weakly striate, hardly more than half as long as petiole; second tergite nearly five times as long as wide at base, its sides nearly parallel, obscurely longitudinally striate, as is also the base of third tergite; ovipositor only about as long as first tergite.

Black and rufous; head black, mandibles, palpi, clypeus at each side, anterior and superior orbits narrowly, and scape beneath yellow, malar space piceous; thorax black with upper posterior part of mesopleura, metapleura except lower margin, and propodeum, except large basal median spot and small apical spot, rufous; scutellum, tegulae, and wing bases yellow; coxae black at base, testaceous at apex, as are also hind trochanters, middle and hind femora, except at apex; hind tibiae and tarsi, rufofuscous, rest of legs testaceous; abdomen with petiole, second tergite, except at apex, and all tergites beyond fourth black, otherwise rufous.

Type-locality.—Mount Washington, New Hampshire, 5,000–5,500 feet.

Other locality.—Hanover, New Hampshire.

Type.—Cat. No. 20253, U.S.N.M.

Described from two females. The paratype differs from the type only in having the yellows and reds slightly paler.

CREMASTUS (CREMASTUS) LONGIVENTRIS, new species.

Female.—Length 13 mm., antennae 7 mm., ovipositor 2 mm. Head in front view subtriangular, eyes distinctly divergent, scarcely as long as greatest width of face, face scarcely elevated in middle, occipital carina broadly interrupted in middle, temples nearly flat, strongly sloping, malar space slightly longer than basal width of mandible, mandibles about two-thirds as wide at apex as at base, interfoveal line about a fourth longer than foveo-ocular line, clypeus subangular at apex, rather strongly convex both longitudinally and in profile, slightly shorter than interfoveal line, suture nearly straight between foveae; lateral ocellar, postocellar, and ocell-ocular lines in about the proportions of 1:2:1.5, the ocelli equal in size, their diameter equal to the lateral ocellar line; face and clypeus finely but distinctly punctate, head otherwise granular, except polished occiput. Thorax strongly tapering, the propodeum sloping nearly from base and extending distinctly beyond middle of coxae; pronotum strongly rugulosopunctate; mesoscutum finely, densely punctate, more strongly so in position of weakly impressed notauli; mesopleura polished and weakly rugulose in longitudinal impression, otherwise as well as sternum densely punctate, sternauli weak; scutellum with distinct

well separated punctures, strongly convex, not margined; metapleura sculptured much like lower part of mesopleura; propodeum with areola and petiolar area separated, the former about four-fifths as long as latter and about twice as long as wide, both areas transversely rugose, basal areas punctate, lateral and pleural areas rugosopunctate: legs very slender, hind basi-tarsus distinctly more than half as long as tibia and about equal to next three joints united, last joint hardly more than half as long as third: wings hyaline; stigma about two-fifths as wide as long, radius arising slightly beyond middle, second abscissa of radius sinuate; second recurrent nearly interstitial, basal vein nearly straight, second discoidal cell about two-fifths as wide at base as at apex, nervulus interstitial, nervellus slightly antefurcal, hardly broken. Abdomen strongly impressed beyond second segment, slightly more than twice as long as head and thorax, petiole cylindrical, without carinae or foveae, much longer than postpetiole, and with the sternite inclosed by the tergite; second tergite about six times as long as wide at base, parallel-sided, longitudinally aciculate, its spiracles in the middle: ovipositor slightly shorter than first tergite.

Rufo-testaceous with lighter and darker markings as follows: Orbits, clypeus, mandibles, palpi, scape below, lower edge of pronotum, notauli, scutellum, coxae at apex, trochanters above, a broad longitudinal band on mesopleura, tegulae, wing bases various shades of yellow, darker on thorax; antennae, facial tubercle, occiput, ocellar triangle, area between scutellum and wings, postscutellum, large triangular spot in basal middle of propodeum and reaching apex of areola, sternauli, petiole at base, second tergite except at apex, third at base, fifth in dorsal middle, and others entirely, hind trochanters at base, and hind tibiae above, black or infuscated.

Type-locality.—Vienna, Virginia.

Other locality.—Wellesley, Massachusetts.

Type.—Cat. No. 20254, U.S.N.M.

Described from two females, the type taken by Mr. W. F. Turner, May 12, 1915, and the paratype captured June 24, 1892. Except for its slightly paler color, especially in the legs, the paratype is like the type.

CREMASTUS (CREMASTUS) RUFICEPS, new species.

Female.—Length 10.5 mm., antennae 6.5 mm., ovipositor 4 mm. Closely related to *longiventris* Cushman from which it differs as follows: Malar space barely as long as basal width of mandibles, which are somewhat broader relatively at apex; face more strongly elevated in middle; interfoveal line nearly a half longer than foveo-ocular line; clypeus only about two-thirds as long as interfoveal line; lateral ocellar, postocellar, and ocell-ocular lines in proportion of 1:1.5:1, ocelli nearly 1. Thorax similarly but less strongly sculptured

throughout; notauli deep anteriorly; scutellum less strongly convex, with strong lateral carinae extending to apex; areola relatively slightly shorter, nearly without rugae, other areas simply punctate; hind basitarsus three-fifths as long as tibia, last joint distinctly more than half as long as third; second recurrent not nearly interstitial, nervellus rather strongly antefurcal. Abdomen hardly twice as long as head and thorax; petiole with dorso-lateral carinae developed toward apex, subparallel-sided, longitudinally aciculate, its spiracles slightly before middle, ovipositor somewhat more than twice as long as first tergite.

Rufous with mandibles, palpi, scape below (orbits not pale) tegulae, and legs, except hind tibiae and tarsi, paler; antennae, occiput, ocellar triangle, a spot above each antenna, longitudinal spot on prescutum, area surrounding scutellum, triangular spot on propodeum reaching to apex of areola, prepectus, first three tergites at base, sixth entirely, and venter black or piceous; hind tibiae subannulate with fuscous at apex and near base, hind tarsi fuscous, pale at base

Type-locality.—Milwaukee, Wisconsin.

Type.—Cat. No. 20255, U.S.N.M.

Described from a single female.

CREMASTUS (CREMASTUS) GRACILIS, new species.

Female.—Length 9 mm., antennae (broken), ovipositor 3 mm. Closely related to *ruficeps* Cushman, with which it agrees in most of the characters distinguishing that species from *longiventris* Cushman, but differing principally as follows: Temples more strongly rounded; clypeus straight in profile, about three-fourths as long as interfoveal line, strongly, evenly rounded at apex; mandibles narrower at apex; malar space distinctly less than basal width of mandible; eyes as long as greatest width of face; lateral ocellar, postocellar, and ocell-ocular lines in proportion of 1:2:1.5, ocelli 1.25; sternauli strong; scutellum with carinae not extending to apex; propodeum with carinae weaker, that separating areola and petiolar area subobsolete; nervellus very slightly postfurcal; abdomen almost exactly twice as long as head and thorax; second tergite distinctly less than four times as long as basal width, distinctly wider at apex, spiracles in middle; ovipositor almost exactly twice as long as first tergite.

Paler testaceous with pale color of head and its appendages, including anterior and lower orbits, yellow; legs pale testaceous, the entire front legs, middle coxae, middle and hind trochanters being nearly yellow, and the hind tibiae and tarsi infuscated, the former paler in middle; antennae brown; dark color of head confined to occiput and ocellar triangle; thorax slightly paler anteriorly but without markings; dark color of abdomen confined to median basal spots on tergites 2 to 6, that of the fourth very weak.

Type-locality.—Lexington, Kentucky.
Type.—Cat. No. 20256, U.S.N.M.
A single female.

CREMASTUS (CREMASTUS) GRACILIPES, new species.

Female.—Length 9 mm., antennae 5.5 mm., ovipositor 3.5 mm. Allied to the three preceding species. Compared with *longiventris* Cushman, it differs as follows: Head in front view more oval; eyes less strongly divergent, fully as long as width of face; face rather strongly elevated in middle, temples strongly rounded; malar space slightly shorter than basal width of mandibles; foveo-ocular line about two-thirds as long as interfoveal line; clypeus broadly rounded at apex, about two-thirds as long as interfoveal line. Thorax stouter, propodeum extending barely beyond middle of coxae; thorax throughout similarly but less strongly sculptured; notauli rather strong anteriorly; sternauli weak; areola only about a half longer than wide and about three-fifths as long as petiolar area; petiolar area only distinctly rugose, others punctate to rugoso-punctate; legs slender; radius arising from very near middle of stigma; second abscissa of radius nearly straight; second recurrent distinctly, though briefly, postfurcal; second discoidal cell nearly half as wide at base as at apex; nervellus strongly antefurcal; mediella entirely obsolete before nervellus. Abdomen almost exactly twice as long as head and thorax; petiole flattened above and with distinct dorso-lateral carinae; second tergite about four times as long as wide at base, considerably wider at apex, finely aciculate; ovipositor about twice as long as first tergite.

Rufo-testaceous with following paler and darker markings; mandibles, palpi, scape below, tegulae and wing bases, notauli, scutellum, legs, except basal and apical annulations of hind tibiae and hind tarsal joints, stramineous (no distinct orbital markings); antennae, occiput, vertex and frons in middle, longitudinal spot on prescutum, spot embracing region about scutellum and base of propodeum as in *longiventris*, all tergites except at apex and at sides beyond second black or piceous.

Type-locality.—East Marsh, District of Columbia.
Host.—*Dicymolomia julianalis.*
Type.—Cat. No. 20257, U.S.N.M.
One female reared from cattail by E. S. G. Titus, July 16, 1903.

CREMASTUS (CREMASTUS) FERRUGINEUS Davis.

Cremastus ferrugineus Davis, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 364.

A single female from southern Illinois agrees with the description in all respects except that the occipital black spot is obsolescent. This specimen was used in placing the species in the key.

CREMASTUS (CREMASTUS) FLAVICEPS, new species.

Female.—Length 7 mm., antennae 4 mm., ovipositor 2 mm. Distinct from the first two species described above in its much shorter malar space and from the last four in its inwardly parallel eyes. Head from in front broadly oval; temples weakly rounded, strongly sloping; eyes straight and parallel within and about as long as width of face; face elevated in middle, impressed at sides, minutely sparsely punctate, foveo-ocular line three-fourths as long as interfoveal line, clypeus about as long as the former, broadly, evenly rounded at apex; malar space equal to basal width of mandible; lateral ocellar, postocellar, and ocell-ocular lines in proportions of 1:2:1.25, ocelli 1; occipital carina weak and broadly interrupted above. Thorax stout, propodeum rather steeply sloping from near base and barely reaching middle of coxae; notauli fairly strong anteriorly; mesonotum distinctly punctate, more sparsely in middle and more densely in positions of notauli; scutellum punctate, strongly convex and with weak lateral carinae extending to apex; thorax laterally rather weakly, sparsely punctate except polished longitudinal, mesopleural impression, sternauli weak, metapleura more strongly punctate; propodeal carinae rather weak, areola and petiolar area not distinctly separated but both transversely rugulose, the combined areas about four times as long as wide at costulae; other areas, especially basal lateral and middle pleural, punctate; legs slender, hind basitarsus little more than half as long as tibia and scarcely as ong as next three joints; stigma about half as wide as long, radius distinctly beyond middle; second abscissa of radius straight nearly to apex; second recurrent very nearly interstitial, basal vein nearly straight, its inner angle with median acute; nervellus interstitial; second discoidal cell slightly less than half as long at base as at apex; all veins of hind wing pale and weak, the nervellus straight and perpendicular. Abdomen less than twice as long as head and thorax; first tergite distinctly longer than second, petiole cylindrical without carinae or foveae, sternite inclosed by tergite; second tergite three times as long as basal width, much wider at apex, longitudinally aciculate; remaining tergites laterally weakly punctate; ovipositor one and one-half times as long as first tergite.

Testaceous; head, including mouth parts and scape beneath, flavous with ocellar triangle black, occiput and spot above each antenna brownish; rest of antennae dark brown; prescutum with a longitudinal dark spot which is nearly black at its anterior and posterior ends and pale brownish in the middle, lateral lobes of mesoscutum brownish; scutellum pale testaceous, surrounded by blackish which extends backward to form a large, subtriangular spot at base of propodeum; prepectus blackish; petiole and second and third tergites blackish at base, the second nearly to apex in middle; wings hyaline.

Male.—Differs from female principally as follows: Ocelli distinctly greater than ocell-ocular line; second recurrent distinctly postfurcal; hind legs, especially tibiae, stouter, postpetiole much narrower and parallel-sided; petiole with weak dorso-lateral carinae; testaceous color of thorax, and to some extent that of abdomen, replaced by yellow; prescutal spot more nearly uniformly brownish; all tergites more or less brownish at base.

A single paratype male differs from the allotype in having the stigma narrower with radius nearly in middle, second recurrent strongly postfurcal, and all tergites beyond third entirely yellow.

Type-locality.—Grand Junction, Colorado.

Other locality.—Port Lavaca, Texas (allotype).

Type.—Cat. No. 20258, U.S.N.M.

Described from one female reared June 2, 1904, from *Pulvinaria bigeloviae* by E. S. G. Titus at the type locality and two males, the allotype collected August 27, 1907, by J. D. Mitchell. The allotype has lost both antennae.

CREMASTUS (CREMASTUS) GRACILIVENTRIS, new species.

Female.—Length 9 mm., antennae 6 mm., ovipositor 3 mm. Related to *flaviceps* Cushman in the entire lack of carinae on the petiole and in the parallel eyes, but otherwise differing as follows: Temples nearly flat; eyes distinctly longer than width of face; foveo-ocular line about two-thirds as long as interfoveal line; clypeus slightly longer, subacutely rounded at apex; malar space slightly less than basal width of mandibles; lateral ocellar, postocellar, and ocell-ocular lines 1:2:1.5, ocelli 1. Thorax more slender, propodeum less steeply sloping, and reaching beyond middle of coxae; mesoscutum nearly uniformly, sparcely punctate; scutellum rather flat above, carinae strong; thorax laterally densely strongly punctate, the longitudinal impression finely rugulose; propodeal carinae rather strong, all areas except basal areas more or less transversely rugulose, median most strongly and pleural least strongly so, the latter also punctate as are the basal areas, the combined areola and petiolar area more than four times as long as wide at costulae; hind basitarsus about three-fifths as long as tibia and fully as long as next three joints; stigma about one-third as wide as long, radius at middle; second recurrent distinctly postfurcal; basal vein rather strongly bent inward; veins of hind wing stronger. Abdomen twice as long as head and thorax; first tergite not distinctly longer than second; second tergite somewhat more than four times as long as basal width, not much wider at apex; ovipositor considerably more than one and one-half times as long as first tergite, though less than twice as long.

Testaceous; head testaceous with mouthparts and orbits yellow, ocellar triangle and small occipital spot blackish; antennae piceous, paler toward base, scape beneath yellowish; thorax nearly uniform

testaceous, without markings, though slightly paler on the prothorax and scutellum; tergites 1 to 3 at base and 5 and 6 entirely piceous or blackish; wings faintly yellowish hyaline.

Type-locality.—Washington, District of Columbia.

Other localities.—Rosslyn, Virginia, Southern Illinois, Ohio, Pennsylvania, Biscayne Bay, Florida.

Type.—Cat. No. 20259, U.S.N.M.

Described from three specimens from the District of Columbia (type and paratypes *a* and *g*), one from Rosslyn, Virginia (paratype *b*), two from Biscayne Bay, Florida (paratypes *c* and *d*), one from Ohio (paratype *e*), one from Pennsylvania (paratype *f*), and one from southern Illinois (paratype *h*). Paratypes *a* and *d* are very like the type, differing slightly in size and in intensity of color at apex of abdomen. Paratype *e* also differs in having the head darker without distinct pale markings (possibly stained); paratypes *f*, *g*, and *h* show progressive degrees of development of a black spot at the base of the propodeum and around the scutellum, and enlargement of the occipital and ocellar spots until in *h* these are broadly united.

CREMASTUS (CREMASTUS) MINOR, new species.

Female.—Length 7 mm., antennae 4 mm., ovipositor 2 mm. Head in front view nearly oval, cheeks below eyes slightly rounded; face in middle elevated, clypeus convex, both transversely and in profile, about two-thirds as long as interfoveal line and about equal to foveo-ocular line, suture curved above foveae; malar space slightly shorter than basal width of mandible; eyes slightly longer than width of face, parallel within; temples strongly rounded; lateral ocellar, postocellar, and ocell-ocular lines 1:1.75:1, ocelli 1. Thorax slender, propodeum gently sloping and reaching distinctly beyond middle of coxae; thorax as a whole rather weakly punctate, polished in the longitudinal impression of mesopleura, notauli distinct anteriorly and more heavily sculptured, sternauli weak; scutellum convex, without carinae; propodeum with areola separated from petiolar area and distinctly shorter, apical areas transversely rugulose, others punctate; legs slender, hind basitarsus about three-fifths as long as tibia and about as long as next three united, last tarsal joint nearly as long as third; stigma two-fifths as wide as long, radius slightly behind middle; second abscissa of radius nearly straight; second recurrent distinctly postfurcal; basal vein nearly straight; nervulus interstitial; nervellus perpendicular, not broken. Abdomen distinctly less than twice as long as head and thorax; first tergite barely longer than propodeum, petiole flattened above, with strong carinae and with sternite nearly inclosed by tergite; second tergite nearly four times as long as basal width of first, not longitudinally aciculate; first two tergites together about as long as rest combined; ovipositor about twice as long as first tergite.

Rufo-testaceous; head yellow with face reddish in middle, occipital and ocellar spots black; antennae dark brown, four basal segments pale beneath; thorax with black V-shaped spot extending from anterior wings to nearly middle of propodeum; scutellum yellowish; prepectus blackish; legs pale testaceous, hind tibiae near base and at apex and tarsi, except at base, infuscated; wing veins rather pale especially in hind wings, where they are nearly colorless. Abdomen with all tergites more or less infuscate dorsally at base, weakly so beyond third, second with black median stripe extending nearly to apex.

Male.—Length 5.5 mm., antennae 4 mm. Eyes nearly one and one-half times as long as width of face; malar space very short; ocelli large, more than twice as great in diameter as ocell-ocular line and nearly equal to postocellar line. Face entirely yellow; dark markings more extensive throughout and more contrasting with pale colors. Otherwise like female.

Type-locality.—New Jersey.

Other localities.—Whitesbog, New Jersey; Pennsylvania; Washington, District of Columbia; Benton Harbor, Michigan; Chicago, Illinois; and Onaga, Kansas.

Type.—Cat. No. 20260, U.S.N.M.

Described from six females and four males as follows: The type female reared by Miss Murtfeldt, June 22, 1890, under Bureau of Entomology No. 928°, as a parasite of *Rhopobota vacciniana;* the allotype reared by H. B. Scammell, August 2, 1915, under Quaintance No. 12681 from the same host, at Whitesbog, New Jersey, paratypes *a* (female) and *h* (male) from Onaga, Kansas; paratype *b* (female) reared July 2, 1902, at Chicago, Illinois, from *Gnorimoschema artemisiella;* paratype *c* (female) reared from an unknown lepidopterous stem borer in Aster (locality unknown); paratype *d* (female) reared by H. G. Ingerson, August 15, 1915, under Quaintance No. 12525, from *Gelechia,* species at Benton Harbor, Michigan; paratype *e* (female) reared May 6, 1912 from pecan cigar case bearer at Victoria, Texas, by J. D. Mitchell; paratype *f* (male) from Pennsylvania; and paratype *g* (male) reared August 8, 1904, from *Eucosma strenuana* on *Ambrosia trifida* at Washington, District of Columbia, by W. D. Kearfott.

Except for some variation in size, the most striking differences displayed by the paratypes in both sexes consist in a gradual increase in the extent of the dark color markings with the addition in *c, d,* and *g* of a prescutellar black spot. The beginnings of this black spot are visible in all of the other paratypes.

CREMASTUS (CREMASTUS) BREVIPETIOLUS, new species.

Female.—Length 9.5 mm., antennae 6 mm., ovipositor 3.5 mm. Eyes very slightly longer than width of face; clypeus narrowly rounded at apex, about two-thirds as long as interfoveal line, foveo-ocular line about three-fifths as long as interfoveal; malar space about two-thirds as long as basal width of mandible; cheeks below eyes straight, not at all rounded; face densely, minutely punctate, head otherwise impunctate; temples weakly rounded; lateral ocellar, postocellar, and ocell-ocular lines in proportion of 1:1.5;1.25, ocelli 1. Thorax rather slender, propodeum gently sloping and reaching about three-fourths of way to apex of coxae; pronotum polished, somewhat weakly rugulose; notauli distinct and more densely sculptured than surrounding area, prescutum more densely punctate than lateral lobes; scutellum polished, sparsely punctate, flattened above and with strong lateral carinae; mesosternum and mesopleura rather densely punctate except in polished longitudinal impression; sternauli weak; metapleura very weakly punctate; propodeum with all, except basal, areas more or less transversely rugulose, especially apically, basal areas very sparsely punctate, shagreened; areola and petiolar area separated, the latter much the longer; hind legs, especially femora, rather stout, basitarsus about two-thirds as long as tibia and nearly as long as remaining four joints together, last joint barely two-thirds as long as third; stigma about two-fifths as wide as long, radius slightly beyond middle; second abscissa of radius nearly straight; second recurrent post-furcal; basal vein nearly straight; nervulus interstitial; nervellus perpendicular, nearly straight. Abdomen distinctly less than twice as long as head and thorax united; first tergite barely as long as propodeum; petiole with lateral carinae strong in front of spiracle, but fading out toward base; sternite inclosed by tergite; postpetiole rising but little above level of petiole; second tergite fully as long as first, slightly more than three times as long as basal width, scarcely wider at apex, longitudinally aciculate; first and second tergites together much longer than remaining tergites united; ovipositor twice as long as first tergite.

Rufo-testaceous; head with face, mouth parts, and orbits yellowish-testaceous, occiput and ocellar triangle black; scape and pedicel pale, flagellum brown, paler at base; prescutum and lobes of mesoscutum slightly infuscate; scutellum yellow, area surrounding it and faintly involving basal middle of propodeum slightly infuscate; legs nearly uniform pale rufo-testaceous, the front coxae and all trochanters slightly paler and hind tibiae and tarsal slightly fuscous; first three tergites infuscate at base, second with longitudinal median stripe reaching about two-thirds of its length.

Male.—Length 8 mm., antennae 5.5 mm. Eyes one and one-half times as long as width of face; malar space practically obsolete; foveo-ocular line less than half as long as interfoveal; lateral ocelli greater in diameter than postocellar line, nearly touching the eyes. Propodeum barely reaching middle of coxae, more weakly sculptured, the rugulosity confined to apical areas; tarsal joints beyond first relatively longer, the basitarsus being barely as long as next three joints; nervulus antefurcal (obliterated below in both wings). First tergite distinctly shorter than propodeum and than second tergite, the two combined not longer than remaining tergites united. Lacks almost entirely infuscation of thorax, and occiput is rufous instead of black.

Type-locality.—Rosslyn, Virginia.

Type.—Cat. No. 20261, U.S.N.M.

Described from one female and one male collected at type locality by H. H. Smith.

CREMASTUS (CREMASTUS) PLATYNOTAE, new species.

Female.—Length 6 mm., antennae 3 mm., ovipositor 2 mm. Head from above more than twice as wide as long, temples weakly rounded; eyes parallel, about as long as width of face; malar space about as long as basal width of mandible; clypeus strongly rounded at apex, about two-thirds as long as interfoveal line, which is nearly twice as long as foveo-ocular line; face shining, weakly punctate, densely so at sides; head otherwise shagreened; diameter of ocelli slightly less than half as long as postocellar line, which is about a third longer than ocell-ocular line. Thorax slender, propodeum gently, arcuately sloping and reaching distinctly beyond middle of coxae; pronotum laterally shagreened, impunctate; mesoscutum sparsely punctate, prescutum more densely so, notauli strong, scutellum punctate, with strong lateral carinae; mesosternum and pleura rather densely punctate, the latter polished, impunctate above; metapleura similarly punctate; propodeal carinae strong, areola and petiolar areas confluent, areas shagreened, very sparsely, weakly punctate, petiolar area sparsely transversely rugose; stigma about two-fifths as wide as long, radius arising in middle; second discoidal cell about one-third as wide at base as at apex; hind basitarsus barely half as long as tibia and much shorter than remaining joints united. Abdomen twice as long as head and thorax, compressed portion less than three times as long as deep, fourth tergite much deeper than third, first and second tergites together slightly longer than rest of abdomen; first longer than second; petiole with carinae obsolete toward base, flattened above toward apex, tergite inclosing sternite, postpetiole strongly elevated above level of petiole; second tergite obscurely striately shagreened, about four times as long as wide at base, slightly wider at apex; ovipositor a little less than twice as long as second tergite.

Head yellow with occiput, vertex, and front black, the spots broadly confluent, scape and pedicel pale below, flagellum black; thorax rufo-testaceous; scutellum yellow; notauli faintly yellowish; tegulae and wing bases whitish; prescutum medially, depression before scutellum, space between scutellum and wings, basal middle of propodeum, metasternum and prespectus black; wings hyaline, veins brown; legs testaceous, front and middle coxae, apices of hind coxae, and all trochanters whitish, hind femora darker, their tibiae and tarsi infuscated. Tergites 1 and 2 and basal middle of others black or piceous, tergites otherwise reddish, paler below.

Male.—Length 5 mm., antennae (broken). Differs from female as follows: Eyes slightly divergent below, shorter than greatest width of face: foveo-ocular line two-thirds as long as interfoveal line; ocelli very little larger; punctuation of thorax throughout less dense; sculpture of propodeum somewhat stronger; petiolar carinae stronger toward base, tergite not completely encircling sternite; postpetiole barely elevated above level of petiole.

Colored like female except that the pronotum is yellow, the depression in front of scutellum is darker; the whole propodeum black; metapleura darker; red color of abdomen replaced by yellowish and dark color more sharply defined.

Type-locality.—Tempe, Arizona.

Host.—Platynota flavedana.

Type.—Cat. No. 20262, U.S.N.M.

Described from two females and two males reared from the host by R. N. Wilson under Webster No. 7205, August, 1914.

Paratype *a* (female) differs from the type in being smaller and in having the prescutal spot less distinct and the petiole piceous, although otherwise generally slightly darker. Paratype *b* (male) is slightly smaller than the allotype, has the propodeum less extensively black, and the matapleura colored like the mesopleura.

CREMASTUS (CREMASTUS) FACILIS (Cresson).

Porizon facilis CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 175.
Porizon macer CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 175.

Both *facilis* and *macer* are represented by paratypes in the United States National Museum, the former only by males and the latter by both sexes. A large series of males from the Belfrage collection and other sources shows that, as suggested by Cresson in his description of *macer*, the two species are undoubtedly the same, at least in the male sex. Whether or not Cresson had the sexes properly associated I do not know, as I have not seen the types of either species, and the only female available is the paratype of *macer*. The males vary in color from those in which the thorax is black or piceous except for the pronotum, notauli, scutellum, and a yellow stripe on the meso-

pleurum to those in which the black is reduced to a small spot at the base of the propodeum and the space between scutellum and wings, and in one specimen even this is obsolete. The head and abdomen vary to almost as great a degree. Besides the Texas specimens, this species is represented from Pennsylvania, Ohio, Iowa, Kansas, District of Columbia, Virginia, North Carolina, Alabama, and New Mexico.

CREMASTUS (CREMASTUS) TORTRICIDIS, new species.

Female.—Length 7 mm., antennae 4 mm., ovipositor 3 mm. Related to *platynotae* Cushman, but differing from it as follows: Diameter of ocelli slightly more than half as long as postocellar line, the latter twice as long as ocell-ocular line. Pronotum laterally weakly striate; second discoidal cell half as wide at base as at apex. Compressed portion distinctly three times as long as deep, third tergite nearly as deep as fourth.

In color very like *platynotae*, but occipital and ocellar spots are separated; prescutum, prepectus, and metasternum not black; black marking of propodeum less extensive; first tergite largely testaceous, black at base, all others black, testaceous at apex.

Host.—*Epagoges sulfureana.*

Type-locality.—Nashville, Tennessee.

Type.—Cat. No. 20263, U.S.N.M.

Described from one female reared with a number of specimens of *C. epagoges*, new species by C. C. Hill under Webster No. 11331.

CREMASTUS (CREMASTUS) DECORATUS Gravenhorst.

Cremastus decoratus GRAVENHORST, Ichn. Eur., vol. 3, 1829, p. 734.
Temelucha plutellae ASHMEAD, Can. Ent., vol. 36, 1904, p. 101.

This species has apparently been introduced into the United States with one of its European hosts, *Evetria buoliana*, a specimen having been reared from that host on Long Island, New York, under Hopkins U. S. No. 13905 L. It is readily distinguished from the American species most closely allied to it by its larger size and highly ornamented thorax. The lateral ocelli in the female are about as broad as the length of the ocell-ocular line and more than half as great as the postocellar line. There is considerable variation in the thoracic color; in the European specimen this is largely black, the type of *plutellae* (Ashmead) has the thorax quite largely yellowish and reddish laterally, while the American specimen is midway between these two in color.

CREMASTUS (CREMASTUS) BREVICAUDA, new species.

Female.—Length 6 mm., antennae 4 mm., ovipositor 1.3 mm. Eyes divergent below, scarcely longer than greatest width of face, face medially elevated and punctate; clypeus nearly as long as interfoveal line which is but little longer than foveo-ocular line; malar space about as long as basal width of mandibles, in front view straight; temples nearly flat; lateral ocellar, postocellar, and ocell-ocular

lines in proportion of 1:1.5:1, ocelli slightly less than 1. Thorax slender, propodeum reaching distinctly beyond middle of coxae; pronotum polished laterally, punctate in upper posterior corner, the punctuation spreading out along dorsal and posterior margins; mesoscutum rather sparsely punctate, more densely so in the weakly impressed notauli; scutellum strongly convex, punctate, with lateral carinae extending weakly to apex; mesosternum and mesopleura punctate except longitudinal impression which is polished and weakly transversely rugulose; metapleura punctate; propodeal carinae weak, all except basal areas and areola, which are very weakly punctate, weakly transversely rugulose, areola and petiolar area separated, the areola slightly the shorter; legs slender, hind basitarsus two-fifths as long as tibia; stigma nearly half as wide as long, radius in middle; angle of radius nearly right; second recurrent postfurcal, cubitus nearly obsolete from shortly beyond recurrent; second discoidal cell scarcely a third as wide at base as at apex; nervulus interstitial; nervellus perpendicular, strongly curved outward. Abdomen only about one and two-thirds times as long as head and thorax, first and second tergites subequal in length, first tergite inclosing sternite, petiole with carinae obsolete toward base, post petiole not rising above level of petiole, only about one and one-half times as wide as petiole; second tergite nearly four times as long as basal width, much wider at apex, longitudinally striate; remaining tergites distinctly shorter than 1 and 2 united; ovipositor little longer than first tergite.

Black; head and thorax with white vestiture; orbits narrowly in front and behind eye, clypeus at apex, mandibles, and palpi yellowish; scape and pedicel ferruginous, paler below; flagellum black; tegulae and wing bases whitish; coxae black, anterior pair pale at apex; legs pale ferruginous, trochanters, except blackish basal segment of hind pair, yellowish; hind legs especially tibiae and tarsi darker; front and middle tibiae whitish above; abdomen black at base and apex, piceous in middle, with apical tergites narrowly yellow ventrally and apically.

Male.—Length 6 mm., antennae 4.5 mm. Eyes parallel within, semiglobose, much longer than width of face; malar space shorter than basal width of mandibles; ocelli nearly as great in diameter as postocellar line, ocell-ocular line very short; postpetiole but little wider than widest portion of petiole; second tergite more than four times as long as basal width, subparallel-sided; orbital ring broad and extending nearly to bottom of eye, clypeus largely yellow; front legs and middle femora yellow in front. Otherwise much as in female.

Type-locality.—Bernadillo County, New Mexico.

Type.—Cat. No. 20264, U.S.N.M.

Described from one female and one male collected May, 1896, by B. Brown.

CREMASTUS (CREMASTUS) EVETRIAE, new species.

Female.—Length 6 mm., antennae 3 mm., ovipositor 2 mm. Allied to *C. brevicauda* Cushman, but differing as follows: Eyes parallel, about as long as width of face; temples rounded; lateral ocellar, postocellar, and ocell-ocular lines in proportion of 1:2:1, ocelli slightly less than 1. Mesoscutum more densely, uniformly punctate; all propodeal areas punctate, the petiolar in addition weakly transversely striate, areola considerably shorter than petiolar; hind basitarsus half as long as tibia; stigma fully half as wide as long, radius arising slightly beyond middle; nervellus slightly antefurcal, straight. Petiole with carinae entirely obsolete, postpetiole swollen and slightly elevated above level of petiole, nearly twice as wide as petiole; ovipositor about one and two-thirds times as long as first tergite.

All coxae black at base, whitish at apex; trochanters pale and legs otherwise darker with same arrangement of colors as in *brevicauda;* abdomen black with yellow ventral and apical markings broad and distinct.

Host.—Evetria bushnelli Busck.

Type-locality.—Fort Bayard, New Mexico.

Type.—Cat. No. 20265, U.S.N.M.

Described from one female reared from the host June 25, 1914, by Carl Heinrich under Hopkins U. S. No. 12101h.

CREMASTUS (CREMASTUS) COOKII Weed.

Cremastus cookii WEED, Ent. Amer., vol. 4, 1888, p. 150.

This species, originally described from specimens reared from *Ancylis comptana* is well represented in the United States National Museum collection, a number of the specimens reared from the type host. These are from Lansing, Michigan, Lexington, Kentucky, Atlantic City and Camden, New Jersey, and Jackson County (State not given). From its nearest relatives, *forbesii* Weed and *epagoges* new species, it is readily distinguished by the very broad stigma, the entire lack of carinae and foveae on the petiole, and the weak-veined, milky white wings. Apparently the orbital ring is always interrupted in the lower posterior orbit, the interruption sometimes extending below the eye, while in the species above mentioned, it is entire, or if interrupted only obscurely so and higher up on the posterior orbit. There is usually a small brown spot at the origin of each notaulus. In the male the lateral ocellus is about equal in breadth to the length of the ocell-ocular line and scarcely half as long as the postocella line. In the male variety *rufus* Weed the only difference is a mixture of more or less red with the yellow of the head.

CREMASTUS (CREMASTUS) EPAGOGES, new species.

Female.—Length 7 mm., antennae 4 mm., ovipositor 3 mm. Head viewed from above much more than twice as wide as long, temples weakly rounded, narrowed; face about as wide as length of eye, elevated in middle, weakly punctate; clypeus rounded at apex, about two-thirds as long as interfoveal line, and slightly longer than foveo-ocular line, the suture straight; malar space subequal to basal width of mandible; diameter of lateral ocellus distinctly less than ocellocular line and barely half as long as postocellar line. Thorax less than twice as long as high, propodeum gently rounded and reaching to middle of hind coxae, generally rather densely, strongly punctate; pronotum rugulose in impression; mesopleurum polished below hind wing, striate nearly to posterior margin of mesoscutum; scutellum weakly convex, strongly carinate laterally; propodeal carinae strong, areola and petiolar area separated, the former slightly the shorter, apical areas transversely rugulose, others sparsely punctate; stigma narrow, radius arising in middle; second discoidal cell nearly half as wide at base as at apex; nervellus straight, perpendicular; legs slender, hind basitarsus about equal to three following joints. Abdomen slightly less than twice as long as head and thorax, first two tergites about equal in length and together longer than remaining segments; first tergite inclosing the sternite, postpetiole swollen, more than twice as wide as petiole, the latter with carinae weak toward base; second tergite narrow, subparallel-sided, striate; compressed portion of abdomen fully a third as deep as long, the third tergite distinctly less deep than fourth; ovipositor scarcely twice as long as first tergite.

Black; occiput, vertex, and front black, face brownish in middle; clypeus, mandibles, and orbits (broadly and completely) yellow; antennae black, scape and pedicel pale beneath; tegulae and lower angle of pronotum yellow; upper hind angle of pronotum, parapsidal lobes anteriorly and laterally, and notauli (obscurely) brownish; scutellum reddish; wings hyaline, venation fuscous; front and middle legs pale testaceous, the coxae and trochanters especially so; hind coxae testaceous, pale at apex and piceous at base; basal joint of trochanter piceous, apical joint pale; femur fusco-testaceous, pale at base and apex; tibia and tarsus fuscous, the former with a pale band in the middle; all tergites black or piceous, yellowish at apex, those beyond second broadly yellow at sides.

Male.—Length 6 mm., antennae 3.5 mm. In addition to the usual secondary sexual characters, differs from female in having the face entirely yellow, the color markings of the thorax yellow instead of brown and more extensive, embracing the entire prothorax, except narrowly in the middle and a broad, interrupted, longitudinal stripe on the mesopleurum; posterior ends of the notauli are broadly

brownish; abdomen more largely black, tergites laterally barely pale margined, second and third obscurely yellowish at apex.

Host.—*Epagoge sulfureana.*

Type-locality.—Nashville, Tennessee.

Type.—Cat. No. 20266, U.S.N.M.

Described from 11 females and 6 males reared under Webster No. 11331, by C. C. Hill.

The paratype females *a–j* exhibit a progressive decrease of the color markings of thorax and abdomen, paratypes *i* and *j* having only the scutellum and narrow lateral margins of the compressed tergites paler than the surrounding areas. Structurally the paratypes differ only minutely from the type. The smallest specimen, paratype *j*, is slightly less than 5 mm. long.

The male paratypes *k* to *o* vary both ways from the allotype, *k*, *l*, and *m* having more yellow and *o* and *p* less. Paratype *k* has a large, quadrate spot of yellow on the mesoscutum, the sternauli also yellow, and the third and fourth tergites largely of that color. Paratype *m* has the notauli black but otherwise it is more yellow than the allotype. The darkest specimen, paratype *o*, lacks the pale notauli and the yellow of the mesopleurum, the pronotum is dark in the lateral impression and the markings of the abdomen are very obscure.

CREMASTUS (CREMASTUS) FORBESII Weed.

Cremastus forbesii WEED, Bull. Ill. Lab. Nat. Hist., vol. 4, 1888, p. 150.

Described by Weed from specimens reared from *Acleris minuta*, this species is represented in the United States National Museum by specimens reared from *Gelechia trialbamaculella* at Pemberton, New Jersey (Quaintance No. 12684), *Rhopobota vacciniana* at the same locality (Quaintance No. 12681), *Gelechia confusella* at Benton Harbor, Michigan (Quaintance No. 12532), and from *Episimus argutanus* at East River, Connecticut. In addition there is one specimen from Colorado.

Except for the characters given in the key the species is very close to *epagoges* Cushman. In some specimens the parapsidal lobes are reddish brown, this color also embracing more or less of the pronotum and mesopleura. The larger ocelli in both sexes furnish the best character for distinguishing the species from its near relatives.

CREMASTUS (ZALEPTOPYGUS) ROSTRATUS, new species.

Female.—Length 7 mm., antennae 4.5 mm., ovipositer 2.5 mm. Head subrostriform; malar space distinctly longer than basal width of mandible, weakly converging; clypeal foveae below level of lower eye margin; clypeus strongly convex transversely, straight in profile, about as long as interfoveal line, the suture arched above foveae, apex

broadly, subangulately rounded; mandibles nearly twice as wide at base as at apex; face flat, slightly narrower than greatest eye length, finely opaquely punctate, a minute median tubercle above; eyes parallel within; ocelli of equal size, diameter about two-thirds as long as ocell-ocular line, which is slightly shorter than postocellar line; occipital carina weakly complete. Thorax short, plump, rather densely clothed with short, white pubescence; pronotum polished, almost without sculpture; notauli and sternauli weakly impressed; mesoscutum opaquely granular with small, well separated punctures; scutellum similarly sculptured, strongly convex and not laterally margined; mesopleura polished above, densely punctate below, this sculpture embracing the sternum; metapleura densely punctate; propodeum short, rounded, not reaching middle of coxae; carinae strong, areola pentagonal, half as long as petiolar area, from which it is strongly separated; apical areas transversely rugulose, others punctate; legs rather stout (both hind tarsi and one hind tibia missing); stigma about three-fifths as wide as long, radius originating well beyond middle, angle of radius about 110°, second abscissa nearly straight, basal vein somewhat incurved, second recurrent well beyond intercubitus; nervellus interstitial, base of second discoidal cell slightly more than half as long as apex, nervellus antefurcal, broken about one-third of the way up, abdomen nearly twice as long as head and thorax, petiole flattened above with dorso-lateral carinae and foveae strong, ventral margins of tergite distant, subparallel; postpetiole polished, rounded, about as long as petiole; second tergite about two and one-half times as long as basal width, considerably wider at apex, longitudinally aciculate; third tergite aciculate at base; ovipositor somewhat less than twice as long as first tergite.

Rufous and black; head with occiput and a broad band embracing vertex and middle of frons and face to a point somewhat below antennae black to brownish, otherwise, including clypeus and mandibles, yellow, slightly darker in middle of face; palpi pale brownish; antennae black with scape and pedicel beneath and apices of flagellar joints pale; prothorax, mesopleura, and apex of propodeum rufous; mesoscutum with prescutum black, lateral lobes fusco rufous, notauli, tegulae, a spot below, and wingbases yellow; mesosternum black; scutellum testaceous, the impression in front, axillae, postscutellum, basal portion of propodeum, and metapleura blackish; abdomen generally blackish with tergites more or less reddish apically and laterally; legs testaceous, the hind one somewhat darker and the hind tibiae lightly infuscated at apex.

Type-locality.—New York, New York.

Type.—Cat. No. 20252, U.S.N.M.

Described from a single female collected by E. B. Southwick, August 20, 1895.

CREMASTUS (ZALEPTOPYGUS) CLERIDIVORUS, new species.

Female.—Length 7 mm., antennae 5 mm., ovipositor 2.7 mm. Head in dorsal view half as long as wide; temples strongly rounded; occipital carina faintly complete; eyes about as long as width of face, fully three-fourths as wide as long, parallel; face punctate, slightly elevated in middle; clypeus broad, nearly straight at apex, about two-thirds as long as interfoveal line and equal to foveo-ocular line; malar space about two-thirds as long as basal width of mandible; cheeks from in front slightly rounded below eyes; ocell-ocular and postocellar lines about equal and nearly twice as long as diameter of ocelli; thorax stout, propodeum strongly arched and not nearly reaching middle of coxae; pronotum laterally shagreened and weakly punctate; notauli strong and strongly, densely punctate, mesoscutum otherwise finely, rather sparsely, punctate; scutellum likewise, without lateral carinae; mesopleura finely punctate, except in longitudinal impression which is polished; sternauli very weak; metapleura rather more densely punctate; propodeal carinae strong, areola and petiolar areas punctate, the latter slightly the shorter and transversely striate, other areas punctate, areola barely half as wide as petiolar area; head and thorax with short, dense, silvery pubescence; stigma about three-fifths as wide as long, radius far beyond middle; second abscissa of radius and basal vein nearly straight; second recurrent postfurcal; nervulus interstitial; nervellus antefurcal and weakly broken below middle; legs slender, hind basitarsus about two-thirds as long as tibia, and nearly as long as other four joints combined. Abdomen barely one and one-half times as long as head and thorax united; first tergite longer than second, its ventral edges subparallel and not enclosing the sternite, the lateral foveae very strong and extending to middle, evenly curved above, the postpetiole not elevated above level of petiole, gradually increasing in width from basal fourth to about apical fourth where the sides become parallel to end, about one-third as wide at apex as long; second tergite slightly less than three times as long as basal width, slightly wider at apex, longitudinally striate; first two tergites slightly longer than others united; ovipositor twice as long as first tergite.

Black; orbits and mouth region yellow; face brown in middle; pronotum rufo-testaceous; tegulae and wing bases stramineous; tergites one and two black, others brownish piceous more or less yellowish apically and laterally; wings hyaline, veins and stigma brown, front and middle legs nearly stramineous; hind legs fusco-testaceous, trochanter and apex of femur pale, tibia in middle and tarsus at base somewhat paler.

Type-locality.—Kanawha Station, West Virginia.

Other localities.—Tryon, North Carolina, Lawrence, Kansas.

Type.—Cat. No. 20267, U.S.N.M.

Described from three females. The type was reared from a clerid larva under Hopkins U. S. No. 2884*g* by Dr. A. D. Hopkins; paratype *a* from Tryon, North Carolina, was reared from the larva of *Enoclerus quariguttatus*, under Hopkins U. S. No. 3635; paratype *b* from Hugo, Kansas, August 13, 1896, No. 557. Both paratypes are much like the type, except that *a* is somewhat smaller with abdomen darker and face paler; and *b* has the mesosternum and pleura reddish piceous with a rufous spot at the upper hind angle, and face paler.

The meager description of *granulatus* Davis gives an impression of an insect very closely related to this and the following species, and one or the other may be found to be synonymous with it. The present species differs from the description of *granulatus* in size, in relative length of ovipositor, in having the propodeal carinae strong at apex, and in the darker pale markings.

CREMASTUS (ZALEPTOPYGUS) SIMILIS, new species.

Female.—Length 7 mm., antennae 4.5 mm., ovipositor 2.7 mm. Very closely related to *cleridivorus* Cushman, from which it differs principally as follows: Head from above more than twice as wide as long; temples less strongly rounded and more sloping; eyes longer than width of face, only two-thirds as wide as long; clypeus strongly rounded at apex; interfoveal line nearly twice as long as foveo-ocular line; ocell-ocular and postocellar lines equal, but diameter of ocelli about three-fourths as great as former. Thorax more slender, propodeum weakly arched, and extending nearly to middle of coxae, areola and petiolar area subequal in length and breadth, each scarcely more than half as wide as long; vestiture of head and thorax not conspicuous. Abdomen twice as long as head and thorax; first and second tergites subequal, first with postpetiole slightly elevated above petiole, of similar conformation but barely one-fourth as wide at apex as long, second nearly four times as long as wide, parallel-sided. Colored almost exactly like *cleridivorus* except that hind legs are paler and scutellum is red.

Type-locality.—Collins, Idaho.

Type.—Cat. No. 20268, U.S.N.M.

One female collected July 27, 1898 by C. V. Piper.

Comparison of the types may show this species to be the same as *granulatus* Davis, but it lacks the dark middle of hind femora, has the propodeal carinae distinct apically, the yellow color is darker than indicated in the description of *granulatus* and the ovipositor is relatively shorter. Also apparently *granulatus* has the scutellum black instead of red.

CREMASTUS (ZALEPTOPYGUS) PLESIUS, new species.

Female.—Length 7 mm., antennae 4 mm., ovipositor 2 mm. Allied to the last two preceding new species. Compared with *cleri-*

divorus Cushman differs as follows: Head in dorsal view more than twice as wide as long; temples less strongly rounded and more sloping; eyes distinctly longer than width of face, parallel, only about two-thirds as wide as long; clypeus broadly but strongly rounded at apex, but little more than half as long as interfoveal line; malar space barely half as long as basal width of mandible; cheeks not rounded below eyes; ocell-ocular line barely half as long as postocellar line, diameter of ocelli distinctly greater than former; propodeum less strongly arched and extending only about one-third of way over coxae; mesopleural impression distinctly, transversely striate; sternauli rather strong; metapleura less densely punctate than mesopleura; areola and petiolar area subequal in length, the areola slightly narrower, petiolar area nearly as wide as long, rather strongly, transversely striate; vestiture of head and thorax inconspicuous; stigma slightly narrower; nervulus briefly postfurcal; hind basitarsus relatively shorter. Abdomen nearly twice as long as head and thorax; postpetiole slightly elevated above level of petiole; ovipositor only about one and one-half times as long as first tergite.

Black; yellow color of head embracing also the face; pronotum, sternauli and lateral edges of mesoscutum yellow; mesopleura and metapleura piceous with an obscure yellowish spot at base of each coxa; scutellum yellowish red; tergites 1 and 2 black, becoming piceous toward apex; other tergites broadly yellowish laterally; legs colored as in *cleridivorus*, but hind legs, especially coxae, paler.

Type-locality.—Probably Michigan.

Type.—Cat. No. 20269, U.S.N.M.

One female from A. J. Cook, Lansing, Michigan, July 30, 1887.

CREMASTUS (ZALEPTOPYGUS) ROSAE, new species.

Female.—Length 6 mm., antennae 4 mm., ovipositor 2.3 mm. Very closely allied to *plesius* Cushman and differing from that species as follows: Eyes barely as long as width of face, about three-fourths as wide as long; clypeus two-thirds as long as interfoveal line; malar space about three-fourths as long as basal width of mandible; cheeks slightly rounded below eyes; ocell-ocular line nearly as long as post-ocellar line, diameter of ocelli nearly as long as former. Propodeum extending about two-fifths of way over hind coxae, areola much narrower than petiolar area, the latter distinctly longer than wide. Abdomen but little more than one and one-half times as long as head and thorax; first and second tergites subequal in length and together but little longer than rest of abdomen; postpetiole only about as long as petiole and rather abruptly swollen.

Color similar to *pleisus* except that entire mesopleura, metapleura, and propodeum, except basal areas, are red.

Type-locality.—Vienna, Virginia.

Type.—Cat. No. 20270, U.S.N.M.

One female reared by the author May 28, 1911, from rose hips in company with *Rhynchytes bicolor*, but which were also apparently infested by a lepidopterous larva, and under Quaintance No. 7084.

CREMASTUS (ZALEPTOPYGUS) DELICATUS (Cresson).

Porizon delicatus CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 176.

The unique type male is in the United States National Museum, as well as two other males also from the Belfrage collection. It is very like *retiniae* (Cresson), and the latter may be merely a darker form of the present species.

The principal characters of the species are given in the key to males.

CREMASTUS (ZALEPTOPYGUS) RETINIAE Cresson.

Cremastus retiniae CRESSON, Rept. Ent. U. S., for 1879, 1880, p. 238.

This species was originally described from a single male specimen reared from (*Retinia*) *Evetria rigidana* (Fernald) at Ithaca, New York. This specimen, minus the head, is in the United States National Museum. In addition there are seven other males, one each from Washington, District of Columbia, and Falls Church, Virginia, and five from Plummers Island, Maryland. The loss of the head of the type makes it impossible to state definitely that these are the same, but the other characters leave little doubt that the determination is correct. About the only difference between this and *delicatus* (Cresson) consists in color, the present species having the propodeum, abdomen, and sometimes the prescutum and mesosternum more or less black or piceous. The specimen that has the dark color most extensively developed has the occiput, vertex, front, prescutum, propodeum, area around scutellum, mesosternum, mesopleura above, metapleura, metasternum, tergites 1, 2, 5, and 7 entirely and 3 and 4 partly black or blackish. The pronotum is yellow, this character allying it to *rosae* Cushman and its close relatives.

CREMASTUS (ZALEPTOPYGUS) TETRALOPHAE, new species.

Female.—Length, 9 mm., antennae 5 mm., ovipositor 3.5 mm. Head from above distinctly more than twice as wide as long; temples weakly rounded and strongly sloping; eyes about a third longer than width of face, parallel within; malar space scarcely half as long as basal width of mandible; clypeus broadly rounded at apex, about two-thirds as long as interfoveal line, which is fully twice as long as foveo-ocular line; ocelli about equal in diameter to ocell-ocular line which is only slightly shorter than postocellar line; occipital carina briefly interrupted above. Thorax stout, the propodeum steeply, arcuately sloping from near the base and extending about two-fifths of way to apex of coxae; pronotum laterally punctate except in middle; mesoscutum rather sparsely punctate, prescutum more

densely so, notauli deep; scutellum sparsely punctate, with lateral carinae extending to apex; mesoscutum and pleura below densely punctate, polished and obliquely striate above; sternauli rather strong; metapleura also densely punctate; propodeum with carinae strong throughout, areola and petiolar area separated, the latter somewhat the longer, about two-thirds as wide as long, areola a little narrower; apical areas obscurely transversely rugose, others densely punctate, except basal lateral areas, which are very sparsely so; stigma about half as wide as long with radius at apical third; second discoidal cell about three-fifths as wide at base as at apex; nervellus antefurcal, broken very near base; hind legs rather stout, basitarsus three-fifths as long as tibia and as long as rest of joints united. Abdomen twice as long as head and thorax, first two tergites slightly longer than rest united, first longer than second; petiole strongly carinate above, sternite not inclosed, lower edges of tergite parallel; postpetiole elevated above level of petiole, striate; second tergite nearly four times as long as wide at base, sides parallel, striate; ovipositor about twice as long as first tergite.

Rufo-testaceous; head darker with mandibles and clypeus inclined to yellowish and vertex slightly infuscated; antennae black, scape and pedicel paler; thorax nearly uniform rufo-testaceous with notauli and scutellum inclined to yellowish; tegulae and wing bases stramineous; wings hyaline, veins and stigma blackish; front and middle legs yellowish stramineous; hind coxae testaceous, trochanters and apices of femora stramineous, femora otherwise brown, tibiae and tarsi fuscous, the latter slightly paler; first and second tergites black, postpetiole piceous, remaining tergites considerably darker than thorax with more or less black in basal middle.

Male.—Length 7.5 mm., antennae 6 mm. Differs from female as follows: Eyes scarcely longer than width of face; postpetiole narrow, parallel-sided beyond spiracles, not swollen, and not elevated above level of petiole; second tergite only about three times as long as wide at base, distinctly wider at apex; hind basitarsus relatively shorter.

Face, orbits, mouth parts, scape and pedicel yellow; occiput, vertex, and front black; prescutum spot in front of scutellum, space between wings and scutellum, and propodeum above black or blackish, scutellum yellow.

Type-locality.—Monticello, Florida.

Host.—*Tetralopha subcanalis* Walker.

Type.—Cat. 20271, U.S.N.M.

Described from three females and three males, all reared from the same host by A. I. Fabis, under Quaintance Nos. 10563, 10564, and 10565. The male is rather remarkable for the genus in that the ocelli are not especially larger than in the female.

Paratype *a* (female) is homotypic and paratype *b* (female) differs in having the orbits and mouthparts distinctly yellow. Paratype *c* (male) is like the allotype except that the propodeum is entirely black, and paratype *d* (male) has the head and mesoscutum colored as in the female paratype *b*.

CREMASTUS (ZALEPTOPYGUS) TEREBRATUS, new species.

Female.—Length 9 mm., antennae 5 mm., ovipositor 6 mm. Compared with *tetralophae* Cushman differs as follows: Eyes scarcely longer than width of face; malar space as long as basal width of mandible; clypeus strongly rounded at apex, about as long as interfoveal line, which is only about a third longer than foveo-ocular line; postocellar line about twice as long as ocell-ocular line, ocelli about equal in diameter to latter. Propodeum precipitate beyond middle and extending barely a third of way over coxae; pronotum laterally punctate throughout; mesoscutum densely punctate throughout, notauli weak; scutellum densely punctate, carinae obsolete toward apex; sternauli obsolete; petiolar area much longer than areola, sculpture of areas similar to that of *tetralophae*, but basal areas are more densely punctate; second recurrent interstitial; second discoidal cell scarcely a third as wide at base as at apex; nervellus unusually strongly antefurcal and broken at lower third; legs slender, hind basitarsus shorter than remaining joints united. Abdomen very slender, twice as long as head and thorax; first two tergites together shorter than rest united; first targite about as long as second, carinae of petiole obsolete toward base; second tergite about four times as long as wide at base, much wider at apex; ovipositor as long as entire abdomen.

Rufo-testaceous; orbits, mouth parts, and cheeks yellow, head otherwise testaceous; antennae black, scape reddish; tegulae and wingbases yellow; space between wings and scutellum and basal areas of propodeum black; thorax otherwise rufo-testaceous with scutellum slightly paler; wings hyaline, veins and stigma brownish; front and middle coxae and trochanters in front, both joints of hind trochanters at apex yellowish; middle and hind trochanters basally black or piceous; hind tibiae with apical half and basal annulus and hind tarsi infuscated, tibiae in middle and at extreme base pale; legs otherwise testaceous, hind coxae and femora much the darkest; abdomen colored as in *tetralophae*.

Type-locality.—Boulder, Colorado.

Type.—Cat. No. 20272, U.S.N.M.

One female collected by Prof. T. D. A. Cockerell at light July 28

CREMASTUS (ZALEPTOPYGUS) MORDELLISTENAE, new species.

Female.—Length 6 mm., ovipositor 2.5 mm. Head viewed from above about twice as broad as long, temples strongly rounded; face

fully a third wider than length of the rather small eyes, slightly elevated in middle, weakly punctate; clypeus weakly separated from face, about two-thirds as long as wide, weakly rounded at apex; malar space about as long as basal width of mandible; ocelli very small, barely more than half as long as ocell-ocular line, which is but little shorter than postocellar line; antennae (broken). Thorax rather stout, about half as deep as long, the propodeum strongly arched and extending about a third of the way over the coxae; clothed with short white pubescence, sculpture rather weak; notauli nearly obsolete; scutellum strongly convex, narrowly rounded at apex, and with lateral carinae weak; propodeal carinae fairly strong, areola and petiolar area separated and about equal in length, the latter transversely rugulose and other areas punctate; stigma about half as broad as long, radius arising distinctly beyond middle; second discoidal cell about a third as wide at base as at apex; legs slender, hind basitarsus about three-fourths as long as tibia and slightly shorter than remaining tarsal joints. Abdomen about one and one-half times as long as basal width, sides gently divergent, weakly longitudinally striate; first two tergites together slightly longer than rest of abdomen; ovipositor slightly more than twice as long as first tergite.

Black; mandibles, clypeus at apex and orbits (narrowly) piceous, the last broadly interrupted below and narrowly so above eyes; antennae black, piceous below toward base; tegulae piceous; legs reddish testaceous, hind coxae entirely and middle coxae at base black, hind tibiae apically and their tarsi fuscous; wings hyaline, venation brownish; abdomen black, obscurely reddish in the middle.

Male.—Length 6 mm., antennae 5 mm. Differs from the female in having the eyes and ocelli somewhat larger, the former only slightly shorter than the width of face, and the latter nearly as long as ocell-ocular line, which is about half as long as postocellar line; malar space narrower than basal width of mandible; the piceous color of head and tegulae is replaced by yellow, and the legs are somewhat paler.

Host.—*Mordellistena morula* LeConte.

Type-locality.—Colorado.

Type.—Cat. No. 20273, U.S.N.M.

Described from one female reared from the host July 9, 1891, and labeled "Ac. Cat. 78" and four males from the same State without host records.

CREMASTUS (ZALEPTOPYGUS) INCOMPLETUS (Provancher).

Mesoleptus incompletus PROVANCHER, Nat. Can., vol. 7, 1875, p. 270.
Atractodes fusiformis PROVANCHER, Nat. Can., vol. 7, 1875, p. 335.
Cremastus fusiformis PROVANCHER, Faun. Can., Hym., 1883, pp. 376 and 788.

Described originally in the genus *Mesoleptus*, this species was redescribed by Provancher later in the same year as *Atractodes fusiformis*.

Eight years later the same writer synonymized the two species and called it *Cremastus fusiformis*. Since *incompletus* has page precedence over *fusiformis*, the earlier name must be used. The fact that Provancher described another species under the name *Atractodes incompletus* does not alter the case, since the present species was never referred to *Atractodes* nor has the name *incompletus* ever been used in *Cremastus*.

From most of the species which fall near it, this species is readily separable by its small size and entirely black thorax and abdomen, and from the few species which approach it in these characters by the very characteristic arrangement of color in the orbits.

CREMASTUS (ZALEPTOPYGUS) ROHWERI, new species.

Female.—Length 8.5 mm., antennae 5 mm., ovipositor 3.3 mm. Head from above more than twice as wide as long, temples strongly rounded; eyes slightly divergent below, slightly shorter than greatest width of face; malar space about as long as basal width of mandible; clypeus little more than half as long as interfoveal line, very weakly rounded at apex; interfoveal line little longer than foveo-ocular line; face weakly elevated in middle, sparsely punctate at sides; anterior orbits swollen; lateral ocelli about half as wide as postocellar line, the latter about one and one-half times as long as ocell-ocular line; occipital carina narrowly interrupted in middle. Thorax rather slender, propodeum declivous beyond middle, but reaching beyond middle of coxae, pronotum laterally deeply impressed and strongly puntate; mesoscutum coarsely punctate, notauli strong; scutellum more finely punctured without lateral carinae; mesosternum and mesopleura coarsely, densely punctured except small polished area immediately below wings; metapleura more finely, sparsely punctured; propodeal carinae strong, areola and petiolar area separated, the latter slightly the longer; apical areas transversely rugulose, areola and basal lateral areas sparsely punctate, other areas densely punctate; stigma half as wide as lang, radius at apical third, second discoidal cell scarcely a third as wide at base as at apex; nervellus strongly antefurcal, not broken; hind legs slender, basitarsus three-fifths as long as tibia and about as long as other four joints united. Abdomen not quite twice as long as head and thorax, first and second tergites subequal in length and together slightly longer than rest of abdomen; petiole with carinae strong to base, ventral edges of tergites separated, parallel, not inclosing sternite, postpetiole elevated slightly above level of petiole; second tergite between five and six times as long as wide at base, its sides almost parallel, longitudinally striate; tergites beyond second strongly compressed; ovipositor about two and one-half times as long as first tergite.

Black with tergites beyond second red; orbits, clypeus, mandibles and scape and pedicel below yellow, and a spot in middle of face yellowish red; flagellum black; tegulae and wing bases whitish; wings hyaline, veins and stigma dark brown; coxae black at base, hind pair largely black, white at apex; all trochanters except basal joint of hind trochanter, which is blackish, white; front legs otherwise stramineous with tarsi paler; hind femora and tibiae fuscous, their tarsi paler, especially at base, middle legs midway in color between front and hind legs; first and second tergites and basal median spot on third black, abdomen otherwise reddish.

Type-locality.—Mount Union, Pennsylvania.

Type.—Cat. No. 20274, U.S.N.M.

One female (Hopkins No. 7557) reared June 17, 1908, by R. W. Van Horn, from a red maple stump infested by Cerambycidae and Eucnemidae and also containing the clerid, *Cymatodera undulata.*

Named for Mr. S. A. Rohwer.

This species presents a rather peculiar combination of characters. The head is of the type shown in *obereae* Viereck and its closest allies, as is also the thorax except for its slenderness and the fact that the propodeum extends beyond the middle of the coxae, both of which, together with the very slender strongly compressed abdomen ally it with the more typical species, but the uninclosed first sternite and broad stigma with distally originating radius refer it without doubt to *Zaleptopygus.*

CREMASTUS (ZALEPTOPYGUS) ANOMALUS, new species.

Female.—Length 7 mm., antennae 3.5 mm., ovipositor 2.3 mm. In the strong compression of the abdomen and lack of scutellar carinae this species is allied to *rohweri* Cushman, but is otherwise abundantly distinct, as follows: Eyes parallel below, distinctly shorter than width of face; malar space distinctly shorter than basal width of mandible; clypeus about two-thirds as long as interfoveal line, weakly convex, strongly rounded at apex; interfoveal line much longer than foveo-ocular line; face evenly, moderately punctate throughout, except narrowly in orbits; anterior orbits not swollen; lateral ocelli much less than half as wide as postocellar line, the latter slightly longer than ocell-ocular line. Thorax stout, the propodeum declivous behind and reaching but a short distance over coxae; thorax throughout much less strongly punctate; scutullum unusually deeply convex, almost appearing swollen; propodeal carinae rather weak, areola and petiolar area weakly separated, the former short, pentagonal much shorter than latter; sculpture of all areas weak, apical areas obscurely rugulose, others punctate; radius arising very shortly beyond middle of stigma; second discoidal cell nearly half as wide at base as at apex; second recurrent interstitial; nervellus perpendicular; hind basitarsus relatively as long compared with tibia but shorter than other joints

united. Petiole with carinae obsolete, the ventral edges of the tergite inclosing the sternite; post-petiole strongly elevated above level of petiole; second tergite about four times as long as basal width, slightly wider at apex, striate.

Color about as in *rohweri*, but face entirely black, scape and pedicel piceous, middle and hind legs paler, hind tibia with whitish stripe above, tergites beyond second dark piceous red.

Type-locality.—Colorado.

Type.—Cat. No. 20275, U.S.N.M.

One female collected by C. F. Baker.

Peculiar in having the petiole as in the more typical species, while otherwise but distantly related to them.

CREMASTUS (ZALEPTOPYGUS) FUSCIPENNIS (Cresson).

Porizon fuscipennis CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 287.

A single female specimen in the United States National Museum collection agrees fairly well with the description of this species. It is from Garden City, Kansas, while the type is from Colorado. This specimen was used in placing the species in the table.

CREMASTUS (ZALEPTOPYGUS) AUDAX (Cresson).

Porizon audax CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 174.

This species, described from the male, is represented in the United States National Museum collection only by that sex, one specimen being a paratype. Its dark wings ally it with *Cremastus fuscipennis* (Cresson) but it differs from that species in having the wings paler and the propodeum less precipitous.

CREMASTUS (ZALEPTOPYGUS) NIGRICLYPEALIS, new species.

Female.—Length 9.5 mm., antennae 4.5 mm., ovipositor 3.5 mm. Head from above strongly transverse, much more than twice as wide as long, temples slightly rounded, from in front subtriangular, malar space as long as basal width of mandible, forming with each other if extended a sharply acute angle, mandibles strongly protruding, clypeus convex, sharply rounded and margined apically, nearly as long as interfoveal line, which is about a half longer than foveo-ocular line; foveae slightly below level of lower eye margins; eyes parallel, barely as long as width of face; face and clypeus strongly, sparsely punctate, polished; cheeks opaque, sparsely punctate; orbits above antennae swollen; antennae inserted slightly below middle of eyes; front subpolished, with a small elevation below anterior ocellus; vertex and posterior orbits sparsely punctate; anterior ocellus distinctly larger than posterior, diameter of latter only about half as long as ocell-ocular line, which is about three-fifths as long as post-ocellar line; antennae but little longer than head and thorax. Tho-

rax stout, propodeum sharply, convexly declivous and reaching to about middle of coxae; thorax densely, coarsely punctate except in polished impressions of pronotum and mesopleura; notauli broad and deep; prescutum flattened above; scutellum with lateral carinae extending to and encircling apex; sternauli and prepectal carina strong; propodeal carinae strong, areola and petiolar area separated, the latter nearly twice as long as areola, about two-thirds as wide as long, widest behind middle; areola hexagonal, as broad as long; stigma more than half as wide as long, radius beyond middle; second discoidal cell about two-fifths as wide at base as at apex; second recurrent interstitial; legs stout, hind basitarsus two-thirds as long as tibia, slightly shorter than rest of tarsus. Abdomen less than one and one-half times as long as head and thorax; first tergite much longer than second, its ventral edges parallel, not inclosing sternite; lateral carinae distinct for only a short distance in front of spiracles, petiole slender, less than half as wide as postpetiole, which is elevated above level of petiole, petiole shining, postpetiole subopaque; second tergite about three and one-half times as long as wide at base, much wider at apex, shagreened and sparsely minutely punctate; ovipositor little more than half as long again as first tergite.

Black with tergites beyond second largely red; head including clypeus black; mandibles, a brief orbital line opposite antennae, and a long narrow line behind eyes yellow; antennae brown, segments paler at apex; palpi piceous; tegulae and wing bases yellow; all coxae and basal joint of hind trochanter below black to piceous; second joints of all trochanters, apices of first joints of front and middle, first joints of hind trochanters above, front and middle tibiae and tarsi above, hind tibiae above except at apex, and apices of all femora white; front and middle legs otherwise testaceous; hind legs otherwise reddish piceous; wings milky hyaline, veins and stigma brown, the latter with a yellow spot at base; tergites 1 and 2 black, others largely dark reddish.

Type-locality.—Las Cruces, New Mexico.

Type.—Cat. No. 20276, U.S.N.M.

One female taken by Prof. T. D. A. Cockerell on *Solidago*, where it had been caught by a *Phymata*, which is mounted on the same pin. Easily recognized by its intensely black clypeus, short antennae, and milky white wings.

CREMASTUS (ZALEPTOPYGUS) VIERECKII (Cockerell).

Porizon viereckii COCKERELL, Ann. and Mag. Nat. Hist., vol. 12, 1903, p. 200.

The badly mutilated male type of this species is in the United States National Museum. In color, pattern of legs, and color of wings it agrees with *nigriclypealis* Cushman, but differs in having the sculpture of head and thorax finer; the antennae long; the orbits broadly

and clypeus at sides yellow; and the propodeum more strongly convex, with the areola relatively longer and narrower, and not reaching so far over the coxae. The eyes are slightly divergent below, about as long as width of face. The ocell-ocular line is about half as long as postocellar line and the ocelli slightly less in diameter than the former, unusually small ocelli for a male of this genus.

CREMASTUS (ZALEPTOPYGUS) BILINEATUS, new species.

Female.—Length 9 mm., antennae 5.5 mm., ovipositor 7 mm Head sparsely, weakly punctate, more densely on face, more than twice as wide as long, temples weakly rounded; eyes parallel, shorter than width of face; face elevated medially; malar space about as long as basal width of mandible; clypeus as long as foveo-ocular line, which is about two-thirds as long as interfoveal line; mandibles protruding. Thorax rather stout, propodeum strongly rounded and extending only a short distance over coxae; upper hind angle of pronotum punctate, rest subpolished; mesoscutum finely punctate, notauli weak; scutellum laterally carinate, flattened, punctate; pleura and sternum finely punctate, mesopleura polished above, sternauli weak; areola about two-thirds as long as petiolar area, elongate pentagonal; petiolar area but little wider than areola, weakly rugulose; other areas weakly punctate, except basal areas, which are smooth; stigma half as long as wide, radius at apical third; second recurrent interstitial; second abscissa of radius curving outward to near apex then forward to costa; second discoidal cell a third as wide at base as at apex; legs slender, hind basitarsus little more than half as long as tibia and about as long as next three joints united. Abdomen twice as long as head and thorax, slender, rather strongly compressed beyond third tergite, tergites 1 and 2 together shorter than remainder of abdomen; first tergite distinctly longer than second, petiole with carinae obsolete toward base, ventral edges of tergite curving toward each other below and partly covering the tergite, postpetiole elevated above level of petiole, nearly three times as broad as narrowest part of petiole; second tergite nearly four times as long as basal width, much wider at apex, striate; ovipositor slightly longer than abdomen.

Black with tergites beyond second largely reddish; head black with orbits broadly and completely, cheeks, clypeus, and mandibles yellow; antennae black, scape and pedicel piceous below; thorax black, notauli, scutellum, tegulae, and wing bases yellow; wings hyaline, veins and stigma brown, latter pale at base; all coxae whitish at apex and above, the amount of white increasing toward the front, black at extreme base, especially hind coxae, otherwise testaceous; front and middle trochanters and front femora whitish in front, otherwise front and middle legs testaceous; both joints of hind trochanter

blackish at base, reddish toward apex with a whitish spot above; hind femora and tibiae rufo-testaceous, the latter infuscated near base and at apex. First tergite entirely and all others more or less at base, black, abdomen otherwise red, paler toward apices and ventral margins of apical tergites.

Male.—Length 7.5 mm., antennae 6.5 mm. Malar space slightly shorter; eyes about as long as width of face; ocelli slightly larger; notauli yellow only in front, and yellow of scutellum confined to a nearly divided crescentic spot; middle as well as hind trochanters black basally, hind coxae almost entirely black; first tergite with carinae stronger and postpetiole relatively narrower and not elevated above level of petiole; black of abdomen more extensive, embracing the entire second, seventh, and eighth tergites and most of the sixth; antennae relatively longer.

Type-locality.—Clementon, New Jersey.

Type.—Cat. No. 20277, U.S.N.M.

One female and one male from type-locality.

In Szepligeti's table this species will run to *Pseudocremastus* Szepligeti, and differs from the description of that genus in minor details principally in venation.

CREMASTUS (ZALEPTOPYGUS) HYALINIPENNIS (Cresson).

Porizon hyalinipennis CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 174.

A paratype female of this species is in the United States National Museum and a male also from the Belfrage collection. It is easily separable from allied species by the characters employed in the key.

CREMASTUS (ZALEPTOPYGUS) GALLAECOLA, new species.

Female.—Length 8 mm., antennae 4.5 mm., ovipositor 3.5 mm. Head viewed from above considerably more than twice as wide as long, temples rather strongly rounded but much narrowed; viewed from in front much broader than long, face twice as broad as long and much broader than greatest length of eye, elevated in middle, rather densely, strongly punctured; clypeus short, broadly rounded at apex, the suture broad, straight, foveo-ocular line nearly as long as interfoveal line; malar space as long as basal width of mandible; eyes prominent, nearly as broad as long, parallel within; diameter of lateral ocellus shorter than ocell-ocular line and about half as long as postocellar line. Thorax about twice as long as high, the propodeum strongly arched above, declivous behind, and reaching barely a third the length of the coxae; thorax very finely pubescent, generally densely, finely punctate, especially the mesopleura below, the mesosternum, and the metapleura; pronotum obscurely striato-punctate; notauli distinct anteriorly; scutellum weakly convex, lateral carinae reaching apex; longitudinal furrow of mesopleurum

obscurely transversely striate; propodeal carinae strong, areola short, pentagonal about two-thirds as long as petiolar area, distinctly separated, apical areas strongly transversely rugulose, others sparsely punctate; stigma slightly more than half as broad as long, radius arising far beyond middle, its two abscissae forming nearly a right angle; second discoidal cell about four times as wide at apex as at base; nervellus slightly curved but unbroken, perpendicular; legs fairly stout, hind basitarsus three-fifths as long as tibia and nearly as long as remaining joints. Abdomen scarcely a half longer than head and thorax, very weakly compressed at apex, tergites 1 and 2 together much longer than remaining segments united; first tergite distinctly longer than second, not inclosing the sternite, its ventral edges parallel, increasing in width from before middle, postpetiole about three times as wide as petiole, not swollen, petiole strongly carinate and foveate; second tergite about three-fifths as broad at base as long, its sides strongly divergent, shagreened and obscurely striate; ovipositor twice as long as first tergite.

Black; clypeus, mandibles, orbits, except broad interruptions above eyes and in lower anterior orbits, narrowly in front and broadly below eyes, yellow; antennae black throughout; tegulae and wing bases yellow; legs generally reddish testaceous, front ones paler, hind coxae black at base, front legs in front, all trochanters, middle and hind tibiae above yellowish, hind tibiae otherwise and their tarsi infuscate; wings hyaline, venation brown, stigma with a longitudinal pale streak; tergites 1 and 2 black, others largely red with apical middle more or less yellow and inclining to black in basal middle, the yellow increasing apically and the black basally.

Male.—Length 7.5 mm., antennae 5 mm. Very like female, even in size of ocelli, and differing principally in color as follows: Orbits more broadly yellow and scarcely interrupted below, front and middle coxae black at base, hind coxae pale only at extreme apex; yellow color of abdomen confined to apex of seventh tergite and lateral edges of others beyond second, the tergites largely black except third and fourth, which are largely reddish. Hind tarsal joints beyond first relatively longer.

Host.—*Gnorimoschema gallae-solidaginis* (Riley).

Type-locality.—East Falls Church, Virginia.

Type.—Cat. No. 20278, U.S.N.M.

Described from 11 females and 6 males reared by the writer during the spring of 1916.

In color this species is very variable, especially in that of the abdomen. The female paratypes *a–j* show a gradual replacing of the red by black, while paratype *i* has the yellow almost entirely obsolete. In paratype *f* the three colors are beautifully arranged in alternating bands on tergites 3 to 6. Aside from color the

greatest degree of variation is shown in the form of the areola, which is sometimes nearly regularly pentagonal. Paratype *a* is most like the type, being practically identical. The male paratypes *k–o* exhibit less variation in color than the females, the extreme being in paratype *o*, in which the red is almost entirely replaced by black. All the male paratypes have the yellow orbits more broadly interrupted below than the allotype.

CREMASTUS (ZALEPTOPYGUS) ORBITALIS (Cresson).

Porizon orbitalis CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 174.
(*Porizon*) *Zaleptopygus orbitalis* (CRESSON) VIERECK, Proc. U. S. Nat. Mus., vol. 41, p. 294.

Originally described by Cresson in *Porizon*, this species is one of the two species referred by Viereck to his genus *Zaleptopygus*. It is represented in the United States National Museum collection by a paratype female and the allotype, the latter without the abdomen, as well as four other males from Texas, two of the latter from the Belfrage collection. Its most striking characters are used in the keys. The specimens available display very little variation, the form of the propodeal areas being most subject to variation. In the male the areola is nearly or quite as long as the petiolar area, and the width of these areas varies considerably.

CREMASTUS (ZALEPTOPYGUS) OBEREAE (Viereck).

Zaleptopygus obereae VIERECK, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 295.

As indicated by Viereck this species is most closely allied to *orbitalis* (Cresson), but is easily distinguished by the characters employed in the key. It is chiefly remarkable for the slight difference in respect to eyes and ocelli between the sexes.

SPECIES NOT TABULATED.

PORIZON ALBIPENNIS Cresson.

Porizon albipennis CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 287.

The type of this species has not been seen nor is there any specimen in the National Museum collection that agrees with the description. It is apparently, however, a *Cremastus* allied by its white wings to *viereckii* (Cockerell) and *bilineatus* Cushman. From both of these it differs in the white apical margins of the tergites. With *bilineatus* it agrees in the unusually long ovipositor.

CREMASTUS ACICULATUS Davis.

Cremastus aciculatus DAVIS, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 364.

Evidently, from the description, this species is closely allied to *plesius* Cushman and *rosae* Cushman, but as it is described only in the male on practically nothing but color characters and as it is well nigh impossible to associate the sexes without biological evidence, it is im-

possible to make a definite statement in the matter. A male in the United States National Museum collection, which agrees in practically all respects with the description, is doubtfully referred to this species.

CREMASTUS GRANULATUS Davis.

Cremastus granulatus DAVIS, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 365.

This species is apparently not represented in the United States National Museum. Judging from the description, however, it is allied to *cleridivora* Cushman and *similis* Cushman, the color pattern of the body being very similar to that of those species. But in its pale yellow legs and apically weak propodeal carinae as well as in its small size, it is distinct from both.

CREMASTUS HARTII Ashmead.

Cremastus hartii ASHMEAD, Bull. Ill. State Lab. Nat. Hist., vol. 4, 1895, p. 277. pl. 3.

In his description of this species Ashmead states "Hab., Havana, Ill.; Washington, D. C.; Lexington, Ky. Types, male and female, in the collections of the Illinois State Laboratory of Natural History, and in my collection."

In the United States National Museum collection there are only four specimens bearing this species label, but only one of these is from either of the localities mentioned in the description. The single exception is a male from Washington, District of Columbia, and is not *hartii* Ashmead, but *retiniae* (Cresson). The other three specimens are a female from Chicago, Illinois, and males from Onaga, Kansas, and New York. Aside from these specimens there are only two specimens from Washington and one from Lexington, Kentucky, which antedate the original description and which at all agree with the description. All three differ more or less from Ashmead's description. Moreover, they are representative of two different species, *C. gracilis* Cushman and *C. graciliventris* Cushman. These specimens and *minor* Cushman which agrees fairly well with the description, were sent to Mr. J. R. Malloch at the Illinois State Laboratory for comparison with the type. Mr. Malloch reported neither species to be *hartii* Ashmead. From his observations it differs from all three species in that the propodeum does not extend to the middle of the hind coxae, but does agree with them in stigmal and petiolar characters. It would therefore run in the table to species to the first part of dichotomy 2, but differs from all the species falling there in the short propodeal neck. Other characters mentioned by Mr. Malloch include: Eyes parallel; malar spaces with extended angle obtuse; areola and petiolar areas separated; petiole with carinae and foveae; second tergites not over two times as long as apical width; length of petiole and second segment barely more than equal the length of remaining segments; abdominal punctures very indistinct.

CREMASTUS NEMORALIS Davis.

Cremastus nemoralis DAVIS, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 364.

From the description, based largely on color, this species is evidently allied to *cleridivora* Cushman and *similis* Cushman. The generally dark thorax with the pale prothorax is a very distinctive color pattern characterizing a small group of closely allied species. *C. nemoralis*, however, differs from all of these in its long ovipositor.

CREMASTUS RECTUS Provancher.

Cremastus rectus PROVANCHER, Nat. Can., vol. 6, 1874, p. 175.

According to notes made by Mr. A. B. Gahan, who has examined the type, this species is undoubtedly a *Cremastus*, and judging by the description of the color it is probably allied to *plesius* Cushman and *rosae* Cushman. From the former it differs in the color of the mesopleura and metapleura and of legs and abdomen, and from *rosae* in the color of the mesoscutum, the latter having the parapsidal lobes red.

LEPTOPYGUS ORBUS Davis.

Leptopygus orbus DAVIS, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 365.

There is no specimen of this species at present available for study, nor is its mention in the present paper intended necessarily to definitely include it in the Cremastini. Mention of it is made to indicate that for a number of reasons it seems very doubtful if it is properly placed in *Leptopygus* and to call attention to a number of characters that seem to ally it more closely to *Cremastus*. All the conclusions in this connection are, of necessity, based on the original description. Four of the characters there given seem to exclude the species from *Leptopygus:* the long ovipositor, the basally narrowed discoidal cell, the completely areolated propodeum, and the opaquely sculptured abdomen. In *Leptopygus* the ovipositor is short and sharply upcurved, the discoidal (third) cell is rather unusually broad at base, the propodeum is not at all or only partially areolated basally, and the abdomen is very highly polished. The same characters that separate the species from *Leptopygus* ally it with *Cremastus*, while other characters, principally of color, remind one very strongly of those species of *Cremastus* placed by Viereck in his genus *Zaleptopygus, Cremastus oberese* (Viereck) and *C. orbitalis* (Cresson). It is the opinion of the writer that this is the proper disposition of the species.

SPECIES ERRONEOUSLY REFERRED TO CREMASTUS.

(CREMASTUS) PROCLITUS LONGICAUDUS (Provancher).

Cremastus longicaudus PROVANCHER, Faun. Can. Hym., 1883, p. 789.

This is a Plectiscine. In Foerster's table to the genera of that tribe it runs to *Eusternix* Foerster, but is certainly congeneric with *Proclitus grandis* Foerster, the genotype of *Proclitus* Foerster, as represented in the United States National Museum collection. It fails to run to the latter genus because of the unbroken nervellus, but the specimen of *P. grandis* examined has this only weakly broken in one wing and unbroken in the other, and this character is evidently not even of specific value.

A specimen of *longicaudus* Provancher compared with the type by Mr. A. B. Gahan and designated by him as a homotype is in the United States National Museum and is the basis of the above remarks.

(CREMASTUS) PROCLITUS MELLIPES Provancher.

Atractodes mellipes PROVANCHER, Nat. Can., vol. 7, 1875, p. 332.
Cremastus mellipes PROVANCHER, Faun. Can. Hym., 1883, p. 377.

According to notes by Mr. A. B. Gahan, who has examined the type, this species is congeneric with *Cremastus longicaudus* Provancher. It must, therefore, be referred to *Proclitus* Foerster.

CREMASTUS PICEUS Cresson.

Cremastus piceus CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 176.

The type of this species is apparently lost, and its exact status can, therefore, not be definitely ascertained. It is not, however, a *Cremastus*, but apparently a member of some genus in the Porizonini. Except for the upcurved ovipositor, the description of the species contains no character that can be considered as at all indicating its relationship.

(CREMASTUS) PROCLITUS ROYI (Provancher).

Cremastus royi PROVANCHER, Faun. Can. Hym., 1883, p. 788.

According to notes by Mr. A. B. Gahan, who has examined the type, this species is congeneric with *longicaudus* (Provancher), and is therefore referred to *Proclitus* Foerster.

THE COLOR OF AMETHYST, ROSE, AND BLUE VARIETIES OF QUARTZ.

By Thomas L. Watson and R. E. Beard,
Of the University of Virginia.

INTRODUCTION.

There is a surprising lack of exact information on the cause of color in minerals, even in many of the common varieties. This is especially true of minerals possessing exotic color in contradistinction to those having natural color, dependent on chemical composition. The literature is largely a foreign one, is comparatively small but scattered, and much of the earlier work is of doubtful value. Again, there is an almost entire lack of reliable analyses involving accurate determinations of the minute quantities of colorative substances (pigments) diffused through minerals which exhibit exotic color.

Decided progress, however, has been made in recent years in the study of cause of color in dispersely colored minerals, many of which are known to be very sensitive to high temperatures and in some cases even to daylight. The chemical nature of the coloring substances is less well known and opinion on the subject is divided. Heating tests for destroying color and its restoration on exposure to the emanations of Roentgen, cathode, or radium rays are used to distinguish between colorative substances of organic and inorganic nature. Also by the use of the ultramicroscope and the application of the principles of colloid chemistry the nature and composition of the substances causing color may be determined.

The present paper gives the results of some experiments recently completed by the writers on the color of several varieties of quartz, and a brief summary and discussion of the work by others on the same varieties of the mineral.[1] There is included on page 559 a note by George Steiger, Chemist to the United States Geological Survey, of some quantitative determinations made of manganous oxide (MnO) in rose quartz from Creede, Colorado, and in amethyst from an unknown locality. Especial attention is directed to the analyses of amethyst and rose quartz from many different localities tabulated on page 554.

[1] The writers are indebted to Dr. Edgar T. Wherry, of the United States National Museum, for helpful suggestions offered on reading the manuscript.

ANALYSES.

Preparation of samples.—Twelve thoroughly clean and fresh representative samples, eight of rose quartz and four of amethyst, from different localities were selected for analysis. Each sample was crushed without grinding in a steel mortar and passed through silk gauze having 13 meshes to the millimeter. The powder was placed in a porcelain dish and dilute hydrochloric acid added and allowed to stand for about 10 minutes, when it was diluted with water, allowed to settle, and the liquid decanted off. This treatment with dilute hydrochloric acid and washing with water was repeated seven or eight times, after which the liquid gave no indication of the presence of iron. The samples were then dried on the water bath and used for analysis.

Methods of analysis.—From 4 to 5 grams of the sample, prepared as outlined above, were accurately weighed into a platinum crucible and treated with a few drops of sulphuric acid and hydrofluoric acid and heated until all silica was volatilized. The residue was fused with sodium carbonate and the melt dissolved in nitric acid. The resulting solution was examined for iron, manganese, titanium, and cobalt, according to the methods outlined by Hillebrand.[1]

Iron was determined by titrating with potassium permanganate solution, 1 cc. of which was equivalent to 0.00067 gram of ferric oxide. Manganese and titanium were determined colorimetrically. The precipitate of cobalt sulphide was so small that it was not feasible to handle it gravimetrically, so that the filter containing it was ignited and the total residue taken up in a borax bead. The color of the beads varied from a faint blue to a clear and distinct blue, but in no case was the bead highly colored.

The results obtained on analysis follow in tabular form:

Partial analyses of amethyst and rose quartz.

[R. E. Beard, analyst.]

No.	Variety.	Constituents determined.			
		TiO_2.	MnO.	Fe_2O_3.	CoO.[2]
I	Amethyst	0.00199	0.00036	0.0775	Distinct blue color.
II	do	.00166	.00068	.0382	Do.
III[3]	do	.00145	.00085	.0404	Do.
IV	do	.00521	.00029	.0935	Do.
V	Rose	.00577	.00052	.0679	Pale blue color.
VI	do	.00139	.00068	.0399	Do.
VII	do	.00269	.00017	.0578	Distinct blue color.
VIII	do	.00288	.00074	.0351	Do.[4]
IX	do	.00288	.00036	.0042	Pale blue color.
X	do	.00495	.00018	.0067	Very pale blue color.
XI	do	.00289	.00057	.0032	Pale blue color.
XII	do	.00293	.00017	.0040	Do.
XIII[5]	Blue	.06900	.....	.5390	

[1] Hillebrand, W. F.: Bull. 422, U. S. Geol. Survey, 1910, 239 pp.

[2] Precipitate of cobalt sulphide was too small to handle gravimetrically but was ignited and taken up in a borax bead with the color results shown in table.

[3] Same as II, except more deeply colored and a single large crystal was used for analysis.

[4] Bead was colored a deeper blue than for any other of the 12 samples analyzed.

[5] Analysis by Robert Robertson. The Virginias, 1885, vol. 6, p. 2.

I. Prince Edward County, Virginia. Collected by William M. Thornton, jr. Furnished by Prof F. P. Dunnington, University of Virginia.
II. Madison County, Montana. Furnished by Foote Mineral Company.
III. Madison County, Montana. Furnished by Foote Mineral Company.
IV. Brazil, South America. Furnished by Foote Mineral Company.
V. Amazon claim, 3 miles north of Texas Creek, Colorado. Furnished by D. B. Sterrett through United States National Museum.
VI. South Dakota. Furnished by United States National Museum. Specimen without number.
VII. Greenland. Furnished by United States National Museum. Cat. No. 9582.
VIII. South Dakota. Furnished by United States National Museum. Cat. No. 84385.
IX. South Dakota. Furnished by United States National Museum. No number.
X. Paris, Maine. Furnished by United States National Museum. Cat. No. 81392.
XI. Southford, New Haven County, Connecticut. Furnished by United States National Museum. Cat. No. 86915.
XII. New York (probably Bedford). Furnished by United States National Museum. Cat. No. 18331.
XIII. Rutile district, Nelson County, Virginia.

As tabulated the figures disclose rather marked variation in each of the constituents for both the amethyst and rose varieties of quartz. When individual analyses are considered, it is observed that amethyst contains the highest percentage each of manganous oxide (MnO) and ferric oxide (Fe_2O_3), while rose quartz shows the highest percentage of titanium dioxide (TiO_2) and the lowest percentage each of manganous oxide (MnO) and ferric oxide (Fe_2O_3). The average percentages of the individual constituents determined for the two varieties of quartz are as follows:

	TiO_2.	MnO.	Fe_2O_3.
Amethyst quartz	0.002577	0.000565	0.006240
Rose quartz	.003185	.000423	.002735

PETROGRAPHY.

A thin section was cut from each of the 12 specimens analyzed (eight of rose quartz and four of amethyst) and studied microscopically. In each thin section the quartz was colorless and exhibited the features common to vein quartz in general. Three of the sections of rose quartz and one of amethyst exhibited slight to distinct wavy extinction, with optical disturbance not noted in either of the other eight slides. Inclusions of varying nature, chiefly mineral (solid) but sometimes liquid, were developed in each slide and in several they were fairly abundant. Their distribution was usually irregular but at times they were partly arranged in lines.

The identity of most of the mineral inclusions could not be definitely established. With only one exception (amethyst), rutile in the form of needle-like inclusions was definitely determined as being present. The rutile inclusions were more abundant in the rose quartz and were only sparingly present in three and entirely absent from one of the amethyst from Brazil (IV in table of analyses, page 554) purchased from the Foote Mineral Company. The larger average titanium content in the rose quartz is shown in the table of chemical analyses on page 555. The minute, dark-colored, dust-like inclusions in both varieties of the quartz were indeterminate as

to composition. They may possibly represent some form of iron oxide or manganese oxide or both.

The evidence gained from microscopic study of the thin sections strongly indicates that the color of the two varieties of quartz can not be ascribed to microscopically visible inclusions, since in general character and abundance the inclusions were apparently not different from those frequently found in ordinary colorless quartz.

HEATING TESTS.

The color of many dispersely colored minerals has been shown to be very sensitive to high temperatures, and in some cases even to sunlight. Such minerals include halite, fluorite, amethyst, smoky quartz, topaz, zircon, tourmaline, etc. To this list should be added rose quartz and green feldspar (amazon stone). Upon testing it is very likely that other minerals will be shown to decolorize on heating.

Previous work.—In 1883 Becquerel[1] showed that the color of the decolorized fluorite and halite was restored on exposure to the cathode rays. More recently Berthelot[2] (1906) and Simon[3] (1908) showed that the color of some of the decolorized minerals is restored on exposure to radium rays, while that of others was not restored by these radiations. From these experiments the conclusion was reached that for the minerals studied (zircon, amethyst, smoky quartz, red tourmaline, and Brazilian topaz by Simon), the color was due to inorganic and not to organic compounds, since exposure to radium rays restored the minerals to their original condition. Berthelot concluded that the coloring substance of smoky quartz, green fluorite, and emerald was organic, since the color of these minerals was not restored on exposure to radium rays after being decolorized by heating. Simon, however, was successful in restoring the color of smoky quartz after it was destroyed by heat, hence excepted to Berthelot's conclusion regarding the nature of the coloring substance of this mineral.

The action of Roentgen, cathode, and radium rays on minerals has been extensively investigated by Kunz and Baskerville.[4]

Work of the writers.—Heating tests were carried out by the writers on fairly large size fragments chipped from hand specimens of amethyst, rose quartz, blue quartz, green feldspar (amazon stone), and green and purple fluorite. The tests were made under uniform conditions in a closed platinum crucible heated in each case for 10

[1] Compt. Rend., 1883, vol. 101, p. 205.

[2] Idem, 1906, vol. 143, p. 477.

[3] Neues Jahrb. f. Min. etc., 1908, vol. 26, pp. 249–295. See translation by Edgar T. Wherry, Mineral Collector, 1908, vol. 15, pp. 165–168, 177–182. Contains numerous references to the literature of the color of minerals.

[4] Science, 1903, vol. 18, p. 769; Mineral Collector, 1904, vol. 11, pp. 82–86. See Lockhart, Amer. Journ. Sci., 1905, vol. 8, p. 95, on luminescence; and Miethe, Ann. des Phys., 1906, vol. 19, p. 633, on the color changes in precious stones produced by radium preparations.

minutes in the flame of a No. 4 Meker burner, which yields a temperature of 1,120–1,140° C. Exact measurement of the temperature to which the minerals were subjected was not made, but it was probably around 1,100° C.

The results of these tests were that the original color of four specimens of amethyst, eight of rose quartz, and one each of green and purple fluorite and green feldspar (amazon stone) was completely destroyed. The minerals were completely decolorized on heating, with the single exception of the deep green feldspar from Amelia County, Virginia, which assumed a faint pinkish color after cooling, due probably to the presence of ferric oxide. The luster on the cleavage surfaces of the feldspar was not affected by the heating.

The color of the deep blue quartz from Nelson County, Virginia, was unaffected after heating for two periods of 10 minutes each, except that a pronounced red color developed along original fracture lines in the mineral on cooling. No change in the original color for other portions of the mineral was observed. Robertson [1] noted that after fusing a fragment of the blue quartz from the same locality before the hot-blast blowpipe flame, the mineral retained its color.

From the results obtained by others it is probable that the color of the minerals tested by the writers would have been destroyed at a lower temperature and in a shorter period of heating. After an exposure for seven months to daylight there is slight indication of the return of the original color in the decolorized specimens of amethyst and fluorite, but not in the rose quartz, blue quartz, or green feldspar.

DISCUSSION OF RESULTS.

Amethyst.—The amethystine color of the amethyst variety of quartz has been attributed to the presence of a variety of substances by different investigators, but it has been generally assumed to be due to the presence of manganese oxide dissolved and diffused through the quartz. Manganic oxide, titanic oxide, sodium ferrate, iron sulphocyanate, and organic matter are substances that have been reported by different writers as the cause of amethystine color in quartz.

Nabl [2] suggested in 1899–1900 that the coloring matter of amethyst is due to the presence of iron sulphocyanate, because the absorption spectrum of amethyst seemed to him to be about the same as that of this compound in ether solution; and he believed that he established this further by analyses showing the presence of sulphur and nitrogen. The more recent work of Berthelot and Simon, briefly summarized below, does not bear out this suggestion.

[1] The Virginias, 1885, vol. 6, p. 2.

[2] Sitzber. Akad. Wiss., Wien, 1899, vol. 2; Min. und Petrog. Mitth., 1900, vol. 19, p. 273.

In 1904 Wherry[1] suggested that the variety of amethyst quartz found in Delaware County, Pennsylvania, was probably colored by a titanium compound, since the microscope showed the presence of rutile inclusions. This might well be questioned in light of the investigations by the senior writer and others on blue quartz, which is discussed below.

In 1906 Berthelot[2] showed that when amethyst is decolorized by heating it regains its violet color on exposure to radium rays. He found that quartz and glass containing small amounts of manganese behaved similarly; hence the color of amethyst was referred by him to a slight manganese content.

The investigation by Simon[3] in 1908 represents the most important contribution thus far made on the color of minerals. By destroying the color of a number of dispersely colored minerals in oxidizing (oxygen), reducing (hydrogen), and when necessary neutral gases, and examination of the chemical character of the resulting gases or distillates, Simon concluded that the colors of the five minerals investigated by him (zircon, amethyst, smoky quartz, tourmaline, and Brazilian topaz) were produced by unstable inorganic compounds. He states that these unstable inorganic compounds are simply rearranged at elevated temperatures but not destroyed, since exposure to radium rays or even to sunlight will restore them to their original condition. According to Simon, the exact nature and constitution of the coloring substances are not known.

The work of the present writers eliminates, it is believed, the probability of inclusions of foreign substances of visible microscopic size as a cause of amethystine color in quartz. While minute inclusions of varying solid and liquid substances were present in the thin sections of amethyst examined microscopically, they were of such character as regards distribution and quantity as not to be seriously considered as a cause of color. In the absence of ultramicroscopic study, the existence of foreign substances of submicroscopic size can neither be denied nor affirmed.

The analyses made of amethyst from different localities and tabulated on page 554 are important in showing appreciable quantities of the iron, manganese, and titanium oxides—metallic oxides which are known to affect the color of minerals. Also the cobalt oxide, a highly colorative substance even in small quantity, was found in each of the four analyses of amethyst in quantity sufficient to impart a distinct blue color when taken up in a borax bead. Examination of the analytical results discloses the fact that both iron and titanium oxides exceed in amount several times that of manganese oxide.

[1] The Mineral Collector, 1904, vol. 11, p. 88.

[2] Compt. Rend., 1906, vol. 143, p. 477.

[3] Neues Jahrb. f. Min. etc., 1908, vol. 26, pp. 249-295. Translated by Edgar T. Wherry, Mineral Collector, 1908-9, vol. 15, pp. 165-168, 177-182.

However, in light of some recent quantitative work on amethyst carried out by George Steiger in the chemical laboratories of the United States Geological Survey, there is proof that the amount of manganous oxide reported in the analysis below is sufficient to produce the depth of color shown in the mineral which he analyzed. The mode of combination of the manganese is not necessarily the same. The amount of manganous oxide found by Steiger is less than that determined by the writers in the four specimens tabulated on page 554.

The results of the investigation by Steiger as prepared by him are published below with his permission.

A. Rose quartz from Creede, Colorado.

B. Clear, fairly dark colored crystals of amethyst, locality unknown.

	A	B
MnO.	0.0002 per cent.	0.00012 per cent.

The minerals were finely powdered, 30 gms. of each were decomposed with sulphuric and hydrofluoric acids and evaporated, the heat being continued until the fluorine had been completely expelled, diluted with water, and filtered.

Silver nitrate was added to the filtrate, manganese oxidized with ammonium persulphate, and determined by comparison of the color of this solution with a standard solution of manganese.

In preparing the first samples a steel block was used in powdering. It was thought manganese might have been introduced through small fragments of steel, and accordingly a second set of ground samples were prepared, this time using an agate mortar in their preparation. Determinations in the second set checked with the first as closely as could be expected.

The following experiment is interesting in showing that such colors as are observed in these minerals can easily be accounted for by the quantities of manganese present.

To 12 cc. of water (this amount roughly representing the bulk of 30 gms. of quartz) was added one-tenth cc. of permanganate solution containing 0.0006 gms. of MnO per cubic centimeter. This solution contained an equivalent amount of manganese per unit volume as the rose quartz; the color produced was of a much darker shade than that of the mineral. A similar experiment was carried out, using an equivalent amount of manganese to that found in the amethyst, and in this case the color of the solution was about that of the mineral.

It is probable that the percentage amount of either of the three metallic oxides found on analysis (table of analyses, p. 554) is sufficient to produce disperse color in quartz. From the known chemical behavior of these substances when small portions are taken up on heating by other bodies, such as borax, salt of phosphorus, glass, etc., manganese produces more exactly the color of amethyst than either the oxide of iron or titanium. In the bead tests with borax and salt of phosphorus, manganese oxide yields amethystine color only when heated in the oxidizing flame, becoming colorless when heated in the reducing flame. The usual explanation for these reactions is that in the former case manganese is converted into a higher form of oxidation and in the latter it is changed by reduction to a lower form—MnO. From the carefully conducted

experiments by Simon on amethyst, the color, if due to manganese—and we believe that it is—seems to be independent of the processes of oxidation and reduction, since he found it was destroyed by heating the mineral in either an oxidizing or a reducing atmosphere, and likewise could be restored on exposure to radium rays in an atmosphere of either oxygen or hydrogen.

From the investigations thus far made into the cause of color of amethyst the following conclusions seem to be warranted: (1) That since the color can be destroyed in an atmosphere of either oxygen or hydrogen and restored in an atmosphere of either, it is independent of the processes of oxidation and reduction, which definitely eliminate organic substances as a cause of the color; (2) that it is due to some inorganic substance whose nature and constitution are yet to be definitely determined; (3) that of the metallic oxides shown to be present in amethyst by chemical analysis, manganese seems to be the most likely one to produce the amethystine color; (4) that the analyses of the mineral show a sufficient quantity of manganese oxide present to produce the color; and (5) that colloidal particles of submicroscopic size, probably manganese oxide, will be found upon ultramicroscopic study to be the cause of the color.

Rose quartz.—A larger number of thin sections of rose quartz from different localities were studied microscopically than of amethyst, but with practically the same results. Irregularly distributed inclusions of the same nature and approximate quantity were observed as in the amethyst, and are not regarded by the writers as having any effect in producing the color.

Eight partial analyses of rose quartz from as many different localities were made, with the results shown in table on page 554. The same metallic oxides (TiO_2, MnO, Fe_2O_3, and CoO) were found as in the amethyst, with somewhat similar variations in each constituent noted when individual analyses are compared. (See p. 559 of this paper determination of manganous oxide in rose quartz from Creede, Colorado, by George Steiger.) Titanium dioxide (TiO_2) averages higher, while manganous oxide (MnO) and ferric oxide (Fe_2O_3) average lower for rose quartz than for amethyst. The color of the borax bead imparted by the very slight amount of cobalt oxide (CoO) present ranged from distinct blue to very pale blue; but on the whole the bead tests indicated probably a smaller content of cobalt oxide (CoO) than for amethyst.

In every case the mineral was completely decolorized on heating, which was to be expected, since it is well known that the color of rose quartz fades on exposure to daylight. The writers did not carry out any tests to determine the restoration of color of the decolorized specimens, but Doelter[1] points out the lack of restoration

[1] Das Radium und die Farben, 1910, pp. 21 and 78.

of color destroyed by heat in the case of rose quartz, which proves that the color is due to organic and not to inorganic substances.[1]

Dana[2] quotes Fuchs as stating that the color is due to titanium, since he found 1 to 1.5 per cent in specimens from Rabenstein, near Bodenmais, and the former (Dana) then remarks that it may come in part from manganese.

From the chemical nature of the metallic substances determined on analysis to be present in rose quartz, the character of inclusions found on microscopic study of thin sections, the complete absence of the slightest indication of the original color being restored in the decolorized specimens on heating after exposure of seven months to daylight, and the lack of restoration of color destroyed by heat on exposure to radium rays by Doelter, the writers conclude that the color of rose quartz can not be attributed to an inorganic substance.

Blue quartz.—By way of contrast it may be of interest here to briefly summarize the results of the investigations into the cause of blue color in some quartz. The occurrence in quantity of beautiful deep sky-blue opalescent quartz in quartzose igneous rocks and at times in metamorphosed sediments derived from them, is known in many localities both in this country and abroad, and has been the subject of investigation in a number. This variety of quartz is by no means uncommon in the Southern Appalachians, and is particularly characteristic of some rock types of the Blue Ridge Mountains and its outliers in Virginia.

The senior writer has examined microscopically many thin sections of blue quartz from different localities in the southeast Atlantic States, and in every case the substance of the quartz was found to be crowded with hairlike inclusions of rutile, which were frequently arranged with more or less crystallographic regularity. On the other hand, quartz of light color or colorless to dark smoky often shows inclusions of rutile needles, with no indication whatever of blue color.

The blue color of the quartz was apparent in thin sections as well as in hand specimens. There is no evidence, however, that the included crystals of rutile observed in the quartz are blue in themselves, although Dana records among the varieties of color for rutile bluish and violet shades. Of the well-known laboratory tests for titanium, two impart a violet color (1) to the salt of phosphorus bead in the reducing flame when cold and (2) to a hydrochloric acid solution when boiled with metallic tin, but neither compound of titanium (Ti_2O_3 and $TiCl_3$), supposed to produce the color, is known to occur in nature.

[1] See p. 559 of this paper for amount of manganous oxide (MnO) found by George Steiger in rose quartz from Creede, Colorado, and description of laboratory experiment.

[2] A System of Mineralogy, 1892, p. 187.

From a chemical and microscopical examination into the cause of the blue color of quartz in Nelson County, Virginia, Robertson[1] concluded that "in view of the color of some of the varieties of titanic oxide, when seen by reflected light, it appears possible that the partial reflection of light by the surfaces of these microscopic crystals occasions the color in question, or the latter may be in a measure due to the interference of light occasioned by these crystals."

Blue quartz occurs as a constituent of the quartz members of the charnockite rock series of India. On microscopic examination Holland found the blue quartz to be crowded with minute hairlike inclusions, presumably rutile, arranged with crystallographic regularity. Concerning the cause of the blue color of the quartz he says: "I conclude that the hairlike inclusions, to which probably the blue color of the quartz is due, are arranged with crystallographic regularity."[2]

In his studies of the quartz-feldspar porphyry in which are developed phenocrysts of sky-blue opalescent quartz from Llano County, Texas, Iddings[3] states that the blue color of the quartz "is undoubtedly due to the reflections of blue light waves from the minute colorless prisms, whose width is a fraction of the length of light waves. It is similar to the blue color of the sky. It is probable, however, that there is also blue light produced by interference of the light reflected from both sides of the minute tabular crystals whose width is also of the order of a fraction of a light-wave length; so that both kinds of phenomena occur within these quartzes."

In the comagmatic area of titanium-bearing rocks of Amherst and Nelson Counties, Virginia, deep blue opalescent quartz both in minute grains and in large masses is an abundant constituent. The blue color of the quartz is pronounced even in thin section, and pressure effects are exhibited chiefly in granulation, fractures, and wavy extinction. The most pronounced microscopic character of the quartz is the presence of abundant closely crowded, minute hairlike inclusions of rutile, which are distributed rather unevenly through each grain. After a detailed study of the quartz from this area by Watson and Taber,[4] the following conclusion as to color was stated: "It seems probable that the blue color of the quartz characterizing the rocks of the Amherst-Nelson Counties area is to be attributed to the multitude of hairlike inclusions as explained by Robertson, Iddings, and Holland."

A different cause of the color of the constantly present blue quartz in the Milford granite of Massachusetts and Rhode Island has been

[1] The Virginias, 1885, vol. 6, pp. 2–3.
[2] Memoirs, Geol. Surv. of India, 1900, vol. 28, pt. 2, pp. 138–139.
[3] Journ. of Geology, 1901, vol. 12, p. 227.
[4] Bull. III–A, Virginia Geol. Survey, 1913, pp. 214–215.

suggested by Emerson and Perry,[1] who state that "a state of strain has probably produced the blue color." They say: "Most of this quartz is blue, and this color appears also in the contact zones and even in the secondary quartz that is found in fragments of schist which are inclosed in the granite and which have been greatly altered by it. The fractured grains of quartz show with polarized light the strongest undulatory extinction, which indicates a state of strain has probably produced the color." The authors do not mention at this place (p. 46) the occurrence in the quartz of rutile inclusions, but that they do occur is shown in a previous statement, where the contact effect of the Milford granite on schists is described. They say: "These grains are often full of rutile needles, like true granite quartz." [2]

The blue quartz of the Virginia rutile area is generally characterized macroscopically by fractures and microscopically in thin sections by undulatory extinction, but the senior writer attributes the blue color of the mineral to the behavior of light on the minute rutile inclusions and not to any state of strain. This view is strengthened by the fact that heating does not destroy the blue color of the quartz.

[1] Bull. 311, U. S. Geol. Survey, 1907, p. 46.
[2] Idem, 1907, p. 32.

GENERIC NAMES APPLIED TO BIRDS DURING THE YEARS 1906 TO 1915, INCLUSIVE, WITH ADDITIONS AND CORRECTIONS TO WATERHOUSE'S "INDEX GENERUM AVIUM."

By Charles W. Richmond,

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The present list is the third[1] one dealing with additions to Waterhouse's useful work. The treatment of names is similar to that of the two earlier lists, except that the genotypes have been determined according to the rules of the International Code of Nomenclature, and derivations of names have been added only when given by the original authors or supplied by them in manuscript. Of the 600 or more names listed in the present paper more than half have been introduced since 1905, a large proportion of these being due to the activities of Mr. Gregory M. Mathews, whose investigations have also brought to light several overlooked names.

I am greatly indebted to Dr. L. Stejneger for verifying several names abroad, and for comparing two Bonaparte reprints with the scarce originals in the "Ateneo Italiano," which he consulted in Florence. I have also to thank Dr. H. C. Oberholser, who has contributed one or more names and assisted me in other ways, and Mr. J. H. Riley, who has called my attention to an overlooked name or two.

Before proceeding to the list of additions I have assembled a series of corrections and other data, arranged categorically, which may prove of use to those who have occasion to consult the "Index".

PRINCIPAL ERRORS IN WATERHOUSE'S "INDEX."

a. Nonavian Names Listed as Birds.

Calliope "Gould," 1836 [=1837], is a mammal.
Capparis Isert, a plant.
Nystactes Kaup, a mammal.
Strychnos "Brehm," a plant.
Thamnocharis Salvin, a reptile.

[1] The earlier papers are entitled "List of generic terms proposed for birds during the years 1890 to 1900, inclusive, to which are added names omitted by Waterhouse in his 'Index Generum Avium'" (Proc. U. S. Nat. Mus., vol. 24, No. 1267, May 2, 1902, pp. 663–729), and "Generic names applied to birds during the years 1901 to 1905, inclusive, with further additions to Waterhouse's 'Index Generum Avium'" (Proc. U. S. Nat. Mus., vol. 35, No. 1656, Dec. 16, 1908, pp. 583–655).

b. Specific Names Listed as Generic Ones.

Chrysocephalus Swainson.
Leucoblephara Lafresnaye.
Tephronotus Hodgson.
Xanthogenius Bonaparte.

c. Nongeneric or Vernacular Names at the Citations Given.[1]

Ara Brisson.
Barbacous Cuvier.
Bernicla Brisson.
Botaurus Brisson.
Cuica Lesson, 1831 [=1830].
Calendula Brisson.
Calidris Brisson.
Cancrophagus [=Cancrofagus] of Brisson.
Canutus Brisson.
Caracara Cuvier, 1817 [=1816].
Cardinalis Brisson.
Cassicus Brisson.
Chaenoramphe Dumont, 1817.
Coua Cuvier, 1817 [=1816].
Cynchramus Brisson.
Episcopus Brisson.
Fregata Brisson.
Furcuria Lesson.
Glaucium Brisson.
Gymnorhines [=Gymnorrhines] Brandt, 1843.[2]
Habia Vieillot.
Hierax Cuvier, 1817 [=1816].
Hortulanus Brisson.
Jabirus Cuvier, 1817 [=1816].
Jacapa Lesson, 1840.
Keron Montin.[3]
Leucomelana [=Leucomelanæ] Bonaparte.
Lorius Brisson.
Maia Brisson.
Mainatus Brisson.
Malcoha Cuvier, 1817 [=1816].
Mariposa Vieillot.
Œgitheles [=Œgithales] Lesson, 1831 (a family name here).
Pelasgie Geoffroy.
Phyllopseuste [=Phyllopseustae] "Meyer u. Wolf," 1815.
Picazuros Lesson, 1837.
Podobes Lesson, 1831.
Psittaca Brisson.
Psittacula Brisson.
Pterorrhines Brandt, 1843.
Rubecula Brisson.
Rubetra Brisson.

[1] A majority of these names have been used generically by later authors.

[2] It is mentioned by Brandt in 1837 (Bull. Sci. Acad. St. Pétersb., vol. 2, p. 347) as *Gymnorhines*, under another group, where also nongeneric.

[3] Adopted by Gray, Handlist, vol. 2, 1870, p. 278, as a subgenus of *Lagopus*

Spreo LESSON, 1831.
Tamatia CUVIER, 1798.
Thriothores LESSON, 1840.
Urubitinga LESSON, 1836.
Xanthomelana [=Xanthomelanæ] BONAPARTE, 1850.

d. ERRORS IN SPELLING AT FIRST CITATION IN THE "INDEX."

Amalsia=*Amalasia*.
Aulacorhamphus GRAY, 1840=*Aulacoramphus*.
Bessonornithos=[*Bessonornis*].
Caicus=*Cacicus*.
Cancrophagus "BRISSON"=*Cancrofagus*, and not generic.
Celeopicus MALHERBE, 1849=*Celeopicos*.
Cerorhyncha BONAPARTE, 1838 [=Lesson, 1831]=*Cerorhynca*.
Chenorhamphus GRAY=*Chenoramphus*.
Chicquera BONAPARTE=*Chiquera*.
Chlamydœna BONAPARTE, "1854," p. 29=*Chlamydæna*.
Chloroktita KAUP=*Chlorokitta*.
Chrysopicus MALHERBE, 1849=*Chrysopicos*.
Coloramphus LESSON, 1839=*Caloramphus*.
Cordylus BONAPARTE=*Cordylis*.
Cractiornis GRAY=*Cracticornis*.
Cyanorhamphus BONAPARTE, 1854=*Cyanoramphus*.
Dendropicus MALHERBE, 1849=*Dendropicos*.
Diphlogæna GOULD, 1854=*Diphogena*.
Dryopicus MALHERBE, 1849=*Dryopicos*.
Entomothera HORSFIELD, "1820"=*Entomotheræ*.
Erythrura SWAINSON, 1837=*Erythura*.
Eteoglaux HODGSON, 1841=*Etoglaux*.
Galastes BONAPARTE, 1856=*Gelastes*.
Gallipicus BONAPARTE, 1854=*Callipicus*.
Geopicus MALHERBE, 1849=*Geopicos*.
Graphophasianus REICHENBACH, "1852" [=1853]=*Graphephasianus*.
Guaruba LESSON, p. 210=*Guarouba*, but is *Guaruba* on p. 211.
Gymnorhines BRANDT, 1843=*Gymnorrhines*, and nongeneric.
Helmintherus BAIRD=*Helmitherus*.
Hierocoglaux KAUP=*Hieracoglaux*.
Holodroma SUNDEVALL=*Halodroma*.
Lamprolophus REICHENBACH=*Lamprolophos*.
Leipoda GOULD=*Leipoa*.
Lepterodias HEMPRICH and EHRENBERG=*Lepterodas*.
Leptorhynchus SWAINSON=*Leptorynchus*.
Leptotriccos CABANIS=*Leptotriccus*.
Leucodiopteron BONAPARTE=*Leucodioptron*.
Leucomelana BONAPARTE=*Leucomelanæ*.
Margaropedrix REICHENBACH, "1852"=*Margaroperdix*.
Megapicus MALHERBE, 1849=*Megapicos*.
Megaquisqualis CASSIN=*Megaquiscalus*.
Megarhynchus THUNBERG=*Megarynchus*.
Melampicus MALHERBE, 1849=*Melampicos*.
Mesopicus MALHERBE, 1849=*Mesopicos*.
Micropicus MALHERBE, 1849=*Micropicos*.
Musciphaga LESSON, "1831"=*Myiophaga*.[1]
Nyctirodius MACGILLIVRAY, 1842=*Nycterodius*.

[1] *Musciphaga* occurs, however, in Lesson, Compl. Buffon, vol. 8, 1837, p. 377.

Ochthocea GRAY, 1849=*Ochthocea.*
Œgitheles LESSON, 1831=*Œgithales* (is nongeneric and not equivalent to *Ægotheles*).
Opetioptela SUNDEVALL=*Opetioptila.*
Opetiorhynchus TEMMINCK, 1820=*Opetiorynchos.*
Pachyrhamphus GRAY, 1840=*Pachyramphus.*[1]
Papusana BONAPARTE, 1855=*Pampusana.*
Perenopterus RAFINESQUE, 1815=*Percnopterus.*
Phaiopicus MALHERBE, 1849=*Phaiopicos.*
Pharomacrus DE LA LLAVE=*Pharomachrus.*
Phragmaticola JERDON, "1844"[=1845]=*Phragamaticola.*
Phyllopseuste "MEYER u. WOLF"=*Phyllopseustae.*
Platyrhynchus DESMAREST, 1805=*Platyrinchus.*
Ploceela OATES, 1882=*Ploceëlla.*
Pogonorhamphus DES MURS=*Pogonoramphus.*
Polydon HODGSON=*Polyodon.*
Priosinus HOMBRON and JACQUINOT=*Priofinus.*
Psalidorhamphos RANZANI=*Psalidoramphos.*
Pteroptochus KITTLITZ, "1831" [=1830]=*Pteroptochos.*
Pygarrhichus BURMEISTER, 1837=*Pygarrhichas.*
Quiscalus RAFINESQUE, 1815=*Quiscalis.*
R[h]amphocorys BONAPARTE, 1850=*Ramphocoris.*
Rhynchæa CUVIER=*Rhynchœa.*
Rhynchomegas BONAPARTE, 1853=*Rhyncomegas.*
Saxicolides[2] LESSON, "1837"=*Saxicoloides.*[3]
Selaspherus REICHENBACH, 1855=*Selasopherus.*
Similonyx SUNDEVALL, 1873=*Smilonyx.*
Sphenorhynchus WIED=*Sphenorynchus.*
Stavorinus BONAPARTE, 1850=*Stavorinius.*
Steganolæma SCLATER and SALVIN=*Stegnolæma.*
Stelidopteryx GLOGER, "1842" [=1841]=*Stelidopterus.*
Stomiopera REICHENBACH=*Stomioptera.*
Talantalos REICHENBACH=*Talantatos.*
Thaumantias BONAPARTE, 1850=*Thaumatias.*
Touyon LACÉPÈDE=*Touyou.*
Trerolæma BONAPARTE, 1855=*Trerolœma.*
Tropidoperdix BLYTH=*Tropicoperdix.*
Vireosylvia BONAPARTE, 1838=*Vireosylva.*
Xanorynchus BONAPARTE, 1855=*Xenorhynchus.*
Xantholæma BONAPARTE=*Xantholœma.*
Xanthomelana BONAPARTE, 1850=*Xanthomelanæ.*
Ypophæna BONAPARTE=*Ypophœa.*
Ziphorhynchus SWAINSON, 1837=*Ziphorynchus.*
Zonaida REICHENBACH=*Zenaida.*

[1] First used by Darwin, Zool. Voyage *Beagle*, pt. 3 (Birds), No. 9, July, 1839, p. 50. He says: "The generic name of Pachyrhynchus *Spix*, is changed by Mr. G. R. Gray to *Pachyramphus*, as the former word is used in entomology." This is a fortunate statement for nomenclature, since the two species mentioned by Darwin are *P. albescens* Gould and *P. minima* Gould, now placed in the genera *Suiriri* (formerly *Empidagra*) and *Habrura*, respectively. *Pachyramphus* as a substitute name for *Pachyrhynchus* Spix, 1825, takes the same type, which is *Pachyrhynchus niger* Spix, by subsequent designation of Swainson (Zool. Illustr., ser. 2, vol. 1, 1829, text to plate 41). Gray, 1840 (List Genera Birds, p. 31), gives the type as *Psaris cuvierii* Swainson, but this will have to give way to Swainson's prior designation. *Pachyrhynchus* of Spix is a composite, containing species of *Pachyramphus*, *Platypsaris*, and *Tityra*. As an equivalent of *Tityra* it had been already used by Wagler (in Hahn, Vögel Asien, Africa, etc., vol. 2, Lief. 13, pl. 6, and text) in 1822, hence is unavailable in the sense of *Pachyramphus* whether preoccupied in entomology or not.

[2] *Saxicolides* is the spelling used by Gray, 1841.

[3] See p. 622.

e. ERRORS OF STATEMENT.

Callicitta KAUP, 1854, is not equivalent to *Callisitta* Bonaparte.
Colorhamphus SUNDEVALL, 1872, is not equivalent to "*Coloramphus*, Less.," as stated.
Dolychronyx LESSON, 1834, does not occur; is 1837.
Geochelidon BREHM, 1831, does not occur; is Cabanis or Gundlach, 1861.
Grammatorhynchus GOULD, 1854, does not occur; is Bonaparte, 1854.
Helospiza BAIRD, 1858, is not a misprint, as inferred, but a subgenus of *Melospiza*.
Herbivocula SWINHOE, is not a misprint, as stated, but a subgenus of *Herbivox*.
Ligurnus HARTLAUB, 1857 [=Bonaparte, 1850]=*Linurgus* Reichenbach, not *Ligurinus* Koch.
Lophorynchus SWAINSON, 1837, is not equivalent to *Lophorhynchus* Vieillot, as stated
Myiapeillea BONAPARTE, 1854, does not occur.
Oceanodroma REICHENBACH, 1849, does not occur; is 1852 (i. e., 1853).
Oriotrochilus REICHENBACH, 1849, does not occur; is Gray, 1869.
Oxyura BONAPARTE, 1828, is not equivalent to *Oxyurus* Swainson.
Poecilopternis KAUP, 1844, does not occur; is Kaup, 1847.
Pteraëtus KAUP, 1847, does not occur; is Kaup, 1850.

f. NOMINA NUDA AT FIRST CITATIONS IN "INDEX."[1]

Achantylops BONAPARTE, 1857. (*Acanthylops*, Gray, Hand-List, vol. 1, 1869, p. 67.)
Acroleptes "SCHIFF" BONAPARTE, 1854. (Cabanis, Journ. Orn., 1861, p. 89.)
Afrotis BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 109.)
Androglossa VIGORS, 1825.
Ardeomega BONAPARTE, 1854. (Comptes Rendus, vol. 40, 1855, p. 722.)
Atricilla BONAPARTE, 1854. (Bruch, Journ. Orn., 1855, p. 287.)
Belurus BONAPARTE, 1854. (Rev. Mag. Zool., 1854, p. 152, is earlier, and valid.)
Bernieria BONAPARTE, 1854. (Pucheran, Arch. Mus., vol. 7, 1855, p. 369.)
Blythipicus BONAPARTE, 1854. (Ateneo Italiano, vol. 2, May, 1854, p. 124, is earlier, and valid.)
Bolborhynchus BONAPARTE, March, 1854. (See beyond, p. 580.)
Bubulcus "PUCHERAN" BONAPARTE, 1854. (Comptes Rendus, vol. 40, 1855, p. 722.)
Buccotrogon KRELING, 1852 (=1853). (Reichenbach, Journ. Orn., 1854, p. 149.)
Busarellus LAFRESNAYE, 1839. (Lesson, Écho du Monde Savant, sér. 2, vol. 8, No. 20, Sept. 10, 1843, col. 468.)
Buscarla BONAPARTE, 1853. (Gray, Cat. Gen. Birds, 1855, p. 79.)
Callipicus BONAPARTE, 1854. (Ateneo Italiano, vol. 2, May, 1854, p. 125, is earlier, and valid.)
Callopsaris BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 146.)
Camelornis REICHENBACH, 1852 (=1853). (Hypothetical subgenus.)
Capnopicus BONAPARTE, 1854. (Ateneo Italiano, vol. 2, May, 1854, p. 125, is earlier, and valid.)

[1] Exclusive of those of Rafinesque, "Analyse," 1815 (listed in Auk, 1909. pp. 52–55); Leach, 1816; Hodgson (in Gray's Zoological Miscellany, 1844), and a few others. Names from Bonaparte's "Conspectus Systematis Ornithologiæ," published in Annales Sci. Nat. (Zoologie), sér. 4, vol. 1, Nos. 2 and 3, 1854, pp. 105–152, are included, as some of them were first published elsewhere, and nearly all of the others are *nomina nuda*. The Nos. 2 and 3 of the "Annales" were received by the Paris Academy of Sciences on May 15 and June 26, 1854 respectively. The dates of receipt of the successive numbers for several years indicates that they were far behind their ostensible dates of publication. On this point a statement in the Nat. Hist. Review, vol. 3, 1856, "Notices," p. 22 (note) is of interest: "These Annals appear usually about half a year after the nominal date on title-page; which must be borne in mind in any question that may arise as to priority."

Completeness is not claimed for this list, but it is sufficiently full to be worthy of insertion here. The supposed earliest date of validity of many of the names is added.

Ceratogymna BONAPARTE, 1854. (Ateneo Italiano, vol. 2, August, 1854, p. 312, is valid.)
Chalcurus BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 103.)
Charidhylas BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 52.)
Cheniscus "BROOKS' Mss." STEPHENS, 1826.
Chlamidochen BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 122, in synonymy.)
Choriotis BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 109.)
Cinclops BONAPARTE, 1854.
Clymenius KAUP, 1829. (Hypothetical genus.)
Collurisoma SWAINSON, 1831 (1832). (Lapsus for *Colluricincla*?)
Cora "REICH." BONAPARTE, 1854.
Cordylus [=Cordylis] BONAPARTE, 1849 (1850).
Coturnicops BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 120.)
Creagrus BONAPARTE, 1854. (Bonaparte, Naumannia, 1854, p. 213.)
Criniger TEMMINCK, 1820.[1]
Cyanopogon "REICH." BONAPARTE, 1854.
Dasornis OWEN, 1869. (Owen, Trans. Zool. Soc. London, vol. 7, pt. 2, 1870, p. 145.)
Delphinella "REICH." BONAPARTE, 1854.
Derbyomiya BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 142, where *Derbyomyia*.)
Dromornis OWEN, 1872. (Owen, Trans. Zool. Soc. London, vol. 8, 1873, p. 381.)
Elisa "REICH." BONAPARTE, 1854.
Exetastus BONAPARTE, 1854. (Cabanis and Heine, Mus. Hein., vol. 2, 1860, p. 83, where *Exetastes*.)
Galachrysia BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 111.)
Gallinulopha BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 121, in synonymy.)
Garrulina BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 148.)
Gorsakius BONAPARTE, 1854.[2] (Gray, Cat. Gen. Birds, 1855, p. 114, where *Goisakius*.)
Granativora BONAPARTE, 1853. (Gray, Cat. Gen. Birds, 1855, p. 79.)
Gymnopithys "SCHIFF" BONAPARTE, 1854.[3]
Hoplopterus BONAPARTE, 1831 (1832). (Gray List Gen. Birds, ed. 2, 1841, p. 84.)
Houbara BONAPARTE, 1831 (1832). (Gray, List Gen. Birds, ed. 2, 1841, p. 83.)
Hydrozetetes "SCHIFF" BONAPARTE, 1854.
Hylocharis MÜLLER, 1835 (1836).
Hylocharis BONAPARTE, 1854.
Hylophila MÜLLER, 1835 (1836).
Hyloterpe CABANIS, 1847.
Ichthiyaetus LAFRESNAYE, 1839.[4]
Iliolopha BONAPARTE, 1854. (Sclater, Proc. Zool. Soc. Lond., 1856, p. 278.)
Kaupornis BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 146.)

[1] A diagnosis is given, but no species is assigned to the genus, so the name is unidentifiable at this point. *Criniger* next appears on the cover of livraison 15 of the Planches Coloriées, 1821, in explanation of plate 88 (*Criniger barbatus* Temminck). *Trichophorus* occurs in the text to the same plate, issued with livraison 21, published in April, 1822. The name *Criniger* is therefore citable from livraison 15, October, 1821, while *Trichophorus* dates from livraison 21, April, 1822. The date for *Trichophorus* cited by H. C. Oberholser (Smithsonian Misc. Colls., Quarterly Issue, vol. 48, pt. 2, 1905, p. 150) is erroneous, owing to his having overlooked the fact that the text for the first 20 livraisons was issued with the twenty-first one.

[2] If Bonaparte's Conspectus, vol. 2, p. 138, is accepted from 1854, the genus will stand as *Gorsachius*.

[3] *Gymnopithys* is available from Bonaparte, Bull. Soc. Linn. Normandie, vol. 2, 1857, p. 35, where used for "Gymnopithys pectoralis, *Schiff, ex Lath.*" [= *Turdus pectoralis* Latham].

[4] Lesson (Écho du Monde Savant, sér. 2, vol. 8, No. 1, Jan. 5, 1843, col. 14) says "*Icthyaëtus*" Lafresnaye is a "nom usité en 1829 par Kaup." For this reason he renamed it *Icthyophaga*, with "*Icthyiophaga*" *javana* Lesson (new name for *Falco ichthyætus* Horsfield) as the only species. In the same year Lafresnaye (Dict. Univ. Hist. Nat., vol. 2, 1843, p. 432) validated the name, as "*Ichthyetus*," with *I. jokowuru* Lafresnaye (new name for *Falco ichthyætus* Horsfield) as the type. *Icthyophaga* Lesson, 1843, should replace *Poliaëtus* (or *Polioaëtus*) Kaup, 1847 (see Proc. U. S. Nat. Mus., vol. 26, 1903, p. 492).

Laterallus BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 120.)
Licornis BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 121.)
Luciania "REICH." BONAPARTE, 1854.
Megabias "VERREAUX" BONAPARTE, 1854.
Melopyrrha BONAPARTE, 1853. (Gray, Cat. Gen. Birds, 1855, p. 82.)
Mosqueria "REICH." BONAPARTE, 1854.
Myiocapta "SCHIFF" BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 146.)
Myiodynastes BONAPARTE, 1854. (Bonaparte, Bull. Soc. Linn. Normandie, vol. 2, 1857, p. 35.)
Myiozeta "SCHIFF" BONAPARTE, 1854. (Sclater, Proc. Zool. Soc. Lond., 1859, p. 46, as *Myiozetetes*.)
Naburupus BONAPARTE, May, 1854.[1]
Neornis HARTLAUB, 1846. (Gray, Gen. Birds, vol. 3, 1849, App., p. 17.)
Nyctiphrynus BONAPARTE, 1854. (Rivista Contemp., vol. 9, 1857, p. 215.)
Nyctiprogne BONAPARTE, 1854. (Rivista Contemp., vol. 9, 1857, p. 215.)
Onychospina BONAPARTE, 1853. (Gray, Cat. Gen. Birds, 1855, p. 79.)
Orbignesius BONAPARTE, 1855.[2]
Oritiscus BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 144.)
Orosterops BONAPARTE, 1854. (Valid as *Oreosterops*, Bonaparte, Comptes Rendus, vol. 38, February, 1854, p. 264.)
Pipromorpha "SCHIFF" BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 146.)
Platypsaris BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 146? or Sclater, Proc Zool. Soc. Lond., 1857, p. 72.)
Primolius BONAPARTE, [March,] 1857. (Bonaparte, April, 1857.)
Ptenornis SEELEY, 1866.
Pteroclurus BONAPARTE, 1854. (Bonaparte, Comptes Rendus, vol. 42, 1856, p. 880.)
Ptilosclera BONAPARTE, March, 1857. (See beyond, p. 619.)
Rabdoglaux BONAPARTE, 1854. (Bonaparte, Rev. et Mag. Zool., sér. 2, vol. 6, for October, 1854, p. 543, where *Rhabdoglaux*.)
Ramphiculus BONAPARTE, 1854. (Bonaparte, Comptes Rendus, vol. 39, November, 1854, p. 878.)
Sayornis BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 146.)
Sericoptila "SCHIFF" BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 145.)
Spizastur LESSON, 1839. (Gray, List Gen. Birds, ed. 2, 1841, p. 3.)
Stiltia BONAPARTE, 1854. (Gray, Cat. Gen. Birds, 1855, p. 111.)
Stokoesiella "REICH." BONAPARTE, 1854.
Struthionanax REICHENBACH, 1852 (1853). (Hypothetical subgenus.)
Struthiopappus REICHENBACH, 1852 (1853). (Hypothetical subgenus.)
Syrichta BONAPARTE, 1854.[3]
Thaumasioptera "SCHIFF" BONAPARTE, 1854.
Urubitinga LESSON, 1839. (Lafresnaye, Dict. Univ. Hist. Nat., vol. 2, 1843, p. 786.)
Ypophæna [=Ypophæa] BONAPARTE, 1854. (Cabanis, Journ. Orn., 1861, p. 91.)
Ypophaia BONAPARTE, 1854. (Gray, Hand-List, vol. 2, 1870, p. 78, equivalent to *Ypophæa*.)

[1] This is really an emendation of *Nabouroupus* Bonaparte (Notes Coll. Delattre, April, 1854, p. 8).

[2] Bonaparte does not seem to have reverted to this name again, but Gray (Cat. Gen. Birds, 1855, p. 147) mentioned it, coupled with the specific name "*typus*." Possibly it is equivalent to the genus *Casiornis* "Bonap." Des Murs, 1855 (type, *C. typus* "Bonap." Des Murs), a member of the Cotingidae.

[3] *Syrichta* (under the spelling "*Syrichtha*") is used by Bonaparte in Bull. Soc. Linn. Normandie, vol. 2, 1857, p. 36, for "Syrichtha curtipes, *Bp.* ex *Sw.*" [= *Tyrannula curtipes* Swainson]. (Refer also to Berlepsch, Novit. Zool., vol. 15, 1908, pp. 128, 129.)

NAMES CITABLE FROM LINNAEUS, SYSTEMA NATURAE, ED. 10, VOL. 1, 1758, BUT QUOTED FROM LATER DATES IN THE "INDEX."

Alauda, p. 165.
Alca, p. 130.
Alcedo, p. 115.
Anas, p. 122.
Ardea, p. 141.
Buceros, p. 104.
Caprimulgus, p. 193.
Certhia, p. 118.
Charadrius, p. 150.
Columba, p. 162.
Colymbus, p. 135 (*Columbus* on p. 84).
Coracias, p. 107.
Corvus, p. 105.
Crax, p. 157.
Crotophaga, p. 105.
Cuculus, p. 110.
Diomedea, p. 132.
Emberiza, p. 176.
Falco, p. 88.
Fringilla, p. 179.
Fulica, p. 152.
Gracula, p. 108.
Hæmatopus, p. 152.
Hirundo, p. 191.
Jynx, p. 112.
Lanius, p. 93.
Larus, p. 136.
Loxia, p. 171.
Meleagris, p. 156.
Mergus, p. 129.
Merops, p. 117.
Motacilla, p. 184.
Mycteria, p. 140.
Otis, p. 154.
Paradisæa, p. 110 (*Paradisea* on p. 83).
Parus, p. 189.
Pavo, p. 156.
Pelecanus, p. 132.
Phaëthon, p. 134.
Phasianus, p. 158.
Phoenicopterus, p. 139.
Picus, p. 112.
Platalea, p. 139.
Procellaria, p. 131.
Psittacus, p. 96.
Psophia, p. 154.
Rallus, p. 153.
Ramphastos, p. 103.
Recurvirostra, p. 151.
Rynchops, p. 138 (*Rhyncops* on p. 84).
Scolopax, p. 145.
Sitta, p. 115.
Sterna, p. 137.
Strix, p. 92.
Struthio, p. 155.
Sturnus, p. 167.
Tantalus, p. 140.
Tetrao, p. 159.
Tringa, p. 148.
Trochilus, p. 119.
Turdus, p. 168.
Upupa, p. 117.
Vultur, p. 86.

NAMES CITABLE FROM LINNAEUS, MUSEUM ADOLPHI FRIDERICI, II, 1764.[1]

Numida, p. 27.
Pipra, p. 32.
Tanagra, p. 30.

NAMES CITABLE FROM LINNAEUS, SYSTEMA NATURAE, ED. 12, VOL. 1 1766.[1]

Ampelis, p. 297.
Buphaga, p. 154 (= *Buphagus* Brisson, 1760).
Cancroma, p. 233.
Didus, p. 267.
Oriolus, p. 160.
Ornitholithus (vol. 3, 1768, p. 157).
Palamedea, p. 232.
Parra, p. 259.
Plotus, p. 218.[2]

[1] Listed here to complete the chronology of Linnaean bird genera.
[2] *Bucco*, *Muscicapa*, *Todus*, and *Trogon* were adopted by Linnaeus in 1766, but date from Brisson, 1760.

NAMES FROM THE ATENEO ITALIANO,[1] VOL. 2, NO. 8, MAY,[2] 1854, PP. 116–129.

(BONAPARTE'S "CONSPECTUS VOLUCRUM ZYGODACTYLORUM."[3])

Apalharpactes, p. 129.
Blythipicus, p. 124.
Brachygalba, p. 129.
Callipicus, p. 125.
Capnopicus, p. 125.
Cerchneipicus, p. 123.
Chotorea, p. 127.
Curucujus, p. 129.
Cyanops, p. 127.
Duvaucelius, p. 129.
Dyctiopicus, p. 123.
Eleopicus, p. 125.
Hypopicus, p. 123.
Hypoxanthus, p. 126.
Leiopicus, p. 123.
Lichtensteinipicus, p. 122.
Malherbipicus, p. 126.
Mulleripicus, p. 122.
Nicoclarius, p. 121.
Oreskios, p. 129.
Pardipicus, p. 124.
Phrenopicus, p. 123.
Pilumnus, p. 123.
Piperivorus, p. 119.[4]
Pipripicus, p. 123.
Pituipicus, p. 126.
Pyrosterna, p. 119.
Pyrotrogon, p. 129.
Ramphomelus, p. 119.[4]
Ramphoxanthus, p. 119.[4]
Reinwardtipicus, p. 122.
Temnotrogon, p. 129.
Trichopicus, p. 123.
Trogonurus, p. 129.
Tucaius, p. 119.
Urogalba, p. 129.
Veniliornis, p. 125.
Xantholœma, p. 127.
Xiphidiopicus, p. 126.
Yungipicus, p. 123.

NAMES FROM THE ATENEO ITALIANO, VOL. 2, NO. 11, AUGUST,[5] 1854, PP. 311–321; NO. 12, SEPTEMBER, 1854, PP. 377–382.

(BONAPARTE'S "CONSPECTUS VOLUCRUM ANISODACTYLORUM.")

Aulea, p. 314.
Ceratogymna, p. 312.
Ceratopipra, p. 316.
Cercophæna, p. 315.
Chiroprion, p. 315.
Coraciura, p. 317.
Corapipo, p. 316.
Corapitta, p. 317.
Cyanalcyon, p. 319.
Dacryophorus, p. 321.
Dasyncetopa, p. 316.
Erythropitta, p. 317.
Gigantipitta, p. 316.
Hæmatoderus, p. 314.
Heteropelma, p. 314.
Hicura, p. 315.
Homraius, p. 312.
Iridipitta, p. 317.
Lepidothrix, p. 316.
Machæropterus, p. 316.
Melanopitta, p. 317.
Porphyrolæma, p. 315.
Rhabdocolius, p. 313.
Schiffornis, p. 314.
Streptoceryle, p. 320.
Urica, p. 318.
Urocolius, p. 313.

[1] These names, although in common use, have been cited almost invariably from the author's repaged separates. They are introduced here to enable writers to quote the original pagination.

[2] Received by the Paris Academy of Sciences on or before June 5, 1854.

[3] The author's edition of this paper does not correspond, page for page, with the original, and there are some additions and omissions of specific names under certain genera.

[4] Valid from Bonaparte, Notes Orn. Coll. Delattre, April, 1854, p. 84 (note).

[5] Received by the Paris Academy of Sciences on or before Aug. 28, 1854. The ostensible date of publication of the Ateneo was the 15th of each month.

CORRECTIONS TO THE FIRST "SUPPLEMENT".

Arinia, p. 668. Should be *Arena*.[1]

Aspatha, p. 669. Vol. 18 should read 17.

Brachycope, p. 670. The type is *Ploceus anomalus* Reichenow, 1887.

Calvifrons, p. 671. This is a *nomen nudum*.

Erythrocnus, p. 682. Should be *Erythocnus*.

Melanocarbo, p. 694. Title requires correction to Bijdragen tot de Taal-Land-en Volkenkunde van Ned.-Indië (4), vol. 7, 1883, p. 119. (*Melanocarbo* is a subgenus of *Carbo*.)

Palæocolymbus, p. 702. Originally misprinted *Palæocolyntus*.

Philomela, p. 706. The author is Link, not Linck.

Phorusrhacos, p. 706. Title should read Enum. Sist., etc.

Porphyreicephalus, p. 708. Should be *Porphyreocephalus*, with the title Vogelbilder aus fernen Zonen, Lief. 6, 1880, text to plate 16.

Ptilocorys, p. 711. Title should read Magyarország Madarai, Fuz. 2.

CORRECTIONS TO THE SECOND "SUPPLEMENT".

Aquilaster, p. 590. Should be *Aquilastur*.

Asturaëtos, p. 592. Author is A. E. Brehm.

Myiornis, p. 623. Is not a subgenus of *Euscarthmus*, as stated.

Neospiza, p. 625. Family is Ploceidæ, not Fringillidæ.

Stipiturops, p. 643. Not a subgenus, as stated.

Tapera, p. 644. See beyond, p. 625.

Xylocota, p. 648. See beyond, p. 629.

ALPHABETICAL LIST OF GENERIC NAMES.

Fossil genera, as in earlier lists, are distinguished by a †.

Acanthinotus SWAINSON, Fauna Boreali-Americana, vol. 2, 1831 [=February, 1832], p. 483.

Type, equivalent to *Oxynotus*[2] Swainson .....[*Campephagidae.*]

(See *Coquus*.)

Achantylops BONAPARTE, Rivista Contemporanea [Torino], vol. 9, fasc. 40, February, 1857, p. 212 (p. 6 of reprint); Salvadori, Atti R. Accad. Sci. Torino, vol. 49, 1914, pp. 447–451.

Type, not mentioned;[3] a *nomen nudum* here.....[*Micropodidae.*]

Acomus REICHENBACH, Synopsis Avium, No. 3, February, 1848, [p. 5].

Type, *Phasianus purpureus* GRAY and *P. erythrophthalmus* RAFFLES.

(Two alleged species=monotypy.).....[*Phasianidae.*]

(Subgenus of *Nycthemerus*.)

Acrorchilus RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 71.

Type, *Synallaxis erythrops* SCLATER.....[*Furnariidae.*]

(Original designation and monotypy.)

Ἄκρος, pointed; ὀρχίλος, a wren. (Ridgway.)

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[1] The title of the paper is "Description d'une espèce nouvelle de Trochilidé par E. Mulsant.—Présentée à la Société Linnéenne de Lyon le 12 octobre 1877." It is reprinted in Mulsant and Verreaux, Hist. Nat. Ois. Mouches, vol. 4, livr. 3, 1878, pp. 193–196.

[2] "We originally proposed the name *Acanthinotus* for this genus, but the word has been already employed in Entomology." The first mention of the name appears to be on p. 168, with the spelling *Acanthonotus*, but it is a *nomen nudum* there.

[3] Through oversight no species was included in this genus, but Gray (Hand-List, vol. 1, 1869, p. 67) adopts "ACANTHYLOPS, *Bp.* 1857" for *Hemiprocne fumigata* (Natterer, MS.) Streubel, and *Cypselus senex* Temminck. (See also *Pallenia*.)

Aëdonops L. BREHM, in Baedeker, Eier der Europaeischen Voegel, Lief. 3, [1855–1858,] text to pl. 19, fig. 19.
Type, "*Lusciniopsis fluviatilis* Bp." [=*Sylvia fluviatilis* WOLF].....[*Sylviidae.*]
(Present designation.[1])

Aëdonopsis[2] (BREHM) REY, Synon. Eur. Brutvögel und Gäste, 1872, p. 164.
Emendation of *Aëdonops* L. Brehm.....[*Sylviidae.*]

Aenopogon "Agass."[3] FITZINGER, Sitzungsber. K. Akad. Wiss. [Wien], vol. 46, 1 Abth., 1863, p. 196.
Type, *Allotrius ænobarbus* TEMMINCK.....[*Laniidae.*]
(Monotypy.)
(Subgenus of *Pteruthius* Swainson.)

Aerodramus OBERHOLSER, Proc. Acad. Nat. Sci. Phila., 1906, July 26, 1906, p. 182.
Type, *Collocalia innominata* HUME.....[*Micropodidae.*]
(Original designation.)
(Subgenus of *Collocalia* Gray.)
Ἀήρ, aer; δραμεῖν, cursare. (Oberholser.)

Aëtos NITZSCH, Pterylographiae Avium, Pars Prior, 1833, p. 21.
Type, "Aquilas et Buteones auctorum continentes".....[*Buteonidae.*]

Afribyx MATHEWS, Birds of Australia, vol. 3, pt. 1, Apr. 2, 1913, p. 41.
Type, *Vanellus lateralis* A. SMITH.....[*Charadriidae.*]
(Original designation and monotypy.)
Africa+ἶβυξ (ἶβις, the ibis). (Mathews, MS.)

Afroxyechus MATHEWS, Birds of Australia, vol. 3, pt. 2, May 2, 1913, p. 124.
Type, *Charadrius tricollaris* VIEILLOT.....[*Charadriidae.*]
(Original designation.)
Africa+*Oxyechus* (ὀξύηχος, sharp, shrilly sounding). (Mathews, MS.)

Agreocantor MAYNARD, Directory Birds Eastern N. A., pt. 9, 1907, p. 243.
Type, *Sylvicola kirtlandii* BAIRD.....[*Mniotiltidae.*]
(Original designation and monotypy.)

[†*Alabamornis*[4] ABEL, Centralbl. für Min., Aug. 1, 1906, pp. 456, 458.
Type, *Alabamornis gigantea* ABEL.]

Alcella STONE, Auk, vol. 24, April, 1907, pp. 197, 198.
Type, *Alca pygmaea* GMELIN.....[*Alcidae.*]
(Original designation and monotypy.)
(Subgenus of *Simorhynchus* Merrem.)
Alca, auk;+ella diminutive. (Stone.)

Alcyon[5] LESSON, Traité d'Orn., livr. 3, July, 1830, p. 240.
Type, *Alcedo alcyon* LINNAEUS.....[*Alcedinidae.*]
(Tautonymy.)

Aline "REICH." BONAPARTE, Annales Sci. Nat. (Zool.), sér. 4, vol. 1, 1854, p. 137.
Type, not mentioned;[6] a *nomen nudum* here.....[*Trochilidae.*]

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[1] *Lusciniola savii* Bonaparte is also mentioned.

[2] This preoccupies *Aedonopsis* Sharpe, 1883, which I now rename *Tychaëdon* (τύχη, a chance, luck +*Aëdon*, ἀηδών, nightingale), type, *Cossypha signata* Sundevall.

[3] *Aenopogon* is listed by Agassiz, Index, 1846, p. 9, as a substitute for *Aenobarbus* "Temm." Agassiz, 1842, but both names are *nomina nuda*. Gray (Cat. Gen. and Subgen. Birds, 1855, p. 54) cites both terms as synonyms of *Allotrius* Boie, and Fitzinger adopts *Aenopogon*, as above.

[4] Proves to be a Zeuglodon.

[5] The genus *Alcyon* of Lesson embraced all of the kingfishers known to him, but of his eight "sous-genre," none is named *Alcyon*. *Alcedo alcyon* Linnaeus, in the second subgenus (p. 242), is the type, by tautonymy. Several authors have cited a genus *Alcyon* of Spix, quoting plate 57, fig. 2, of his Avium Species Novae as "*Alcyon tridactyla*," but the bird there represented is called *Galbula tridactyla* in the copy seen by me.

[6] See also Gray, Cat. Gen. and Subgen. Birds, 1855, p. 142, where listed as a doubtful synomym of *Engyete* Reichenbach.

Alisteranus MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 433.
Type, *Amadina cincta* GOULD.....[*Ploceidae.*]
(Original designation.)
For Alister William Mathews, 1907– (Mathews, MS.)

Alisternornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 111.
Type, *Pachycephala lanioides buchanani* MATHEWS.....[*Muscicapidae.*]
(Original designation and monotypy.)
For Alister William Mathews, 1907– (Mathews, MS.)

Alisterus MATHEWS, Novit. Zool., vol. 18, No. 1, June 17, 1911, p. 13.
Type, *Psittacus cyanopygius* VIEILLOT.....[*Cacatoidae.*]
(Original designation and monotypy.)
For Alister William Mathews, 1907– (Mathews, MS.)

Alophus MALHERBE, Monogr. Picidées, vol. 1, 1861 [=1860], p. 47.
Type, *Picus gutturalis* VALENCIENNES[1].....[*Picidae.*]
(Present designation.)
(Section of *Dryopicos* Malherbe.)

Alphachlamydera MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 112.
Type, *Chlamydera cerviniventris* GOULD.....[*Ptilonorhynchidae.*]
(Original designation.)
"Αλφα, first+*Chlamydera* (χλαμύς (χλαμυδ-), mantle; δέρη, neck). (Mathews, MS.)

Alphacincla MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 110.
Type, *Colluricincla woodwardi* HARTERT.....[*Prionopidae.*]
(Original designation.)
"Αλφα, first; κίγκλος, a kind of bird. (Mathews, MS.)

Alphagygis MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 110.
Substitute name for *Gygis* Wagler, 1832 (preoccupied by *Gyges* Bory de St. Vincent, 1825).....[*Laridae.*]
"Αλφα, first+*Gygis* (γύγης, a fabulous bird). (Mathews, MS.)

Alphapuffinus MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 110.
Type, *Puffinus assimilis* GOULD.....[*Puffinidae.*]
(Original designation.)
"Αλφα, first+*Puffinus*. (Mathews, MS.)

Alphaturnia MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 112.
Type, *Hemipodius velox* GOULD.....[*Turnicidae.*]
(Original designation and monotypy.)
"Αλφα, first+*Turnix* (contraction of *coturnix*, a quail). (Mathews, MS.)

Amazilina EUDES-DESLONGCHAMPS, Annuaire Musée Hist. Nat. Caen, vol. 1, "Année 1880," pp. 391, 405.
Type, *Trochilus fuscicaudata* FRASER.....[*Trochilidae.*]
(Monotypy.)
(A section of *Amazilis*.)

Amimeta MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 63.
New name for *Mimeta* Vigors and Horsfield, 1827 (not *Mimetes* Eschscholtz, 1818).
[*Oriolidae.*]
'A, without+*Mimeta* (μιμητής, an imitator). (Mathews, MS.)

[1] There are three crestless Asiatic species in the second section of Malherbe's genus *Dryopicos*, *Picus gutturalis* Valenciennes, *P. fulvus* Quoy and Gaimard, and *P. funebris* Valenciennes. The first may be regarded as the type, making *Alophus* a synonym of *Mulleripicus* Bonaparte, 1854. It is also preoccupied by *Alophus* Schönherr, 1826.

Amirafra BIANCHI, Bull. Acad. Imp. Sci. St.-Pétersb., sér. 5, vol. 25, No. 1-2, January, 1907, p. 12.
Type, *Mirafra collaris* SHARPE.....[*Alaudidae.*]
(Original designation and monotypy.)
(Subgenus of *Mirafra.*)

Amoropsittaca RICHMOND, Proc. Biol. Soc. Washington, vol. 28, Nov. 29, 1915, p. 183.
Type, *Arara aymara* D'ORBIGNY.....[*Psittacidae.*]
(Original designation and monotypy.)
Ἄμορος, unlucky; ψιττάκη, a parrot.

Ampeleia REICHENOW, Journal für Orn., vol. 61, Heft 3, July, 1913, p. 555.
Type, *Ampelis cinctus*[1] TSCHUDI (=*Cotinga tschudii* GRAY).....[*Cotingidae.*]
(Monotypy.)

†**Amphiserpentarius** GAILLARD, Annales Univ. Lyon, nouv. sér., vol. 1, Sciences, Médecine, fasc. 23, 1908, p. 44.
Type, *Amphiserpentarius schlosseri* GAILLARD.....[*Sagittariidae.*[2]]
(Monotypy.)

Anabatoides DES MURS, in Chenu, Encycl. Hist. Nat., Ois., vol. 3, [1853], pp. 144, 145, fig. 148.
Type, "*Anabatoides fuscus*, VIEILLOT" [=*Sitta fusca* VIEILLOT]...[*Furnariidae.*]
(Present?[3] designation.)

Angroyan "Temminck" ILLIGER, Abh. K. Akad. Wiss. Berlin (Phys. Kl.), 1812-13, 1816, p. 231; MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 99.
Type, *Loxia cyanoptera* LATHAM.....[*Artamidae.*]
(Monotypy.)
(See also *Pseudartamus* Mathews, 1912.)

Anomalopterus "Schiff.?" GRAY, Cat. Gen. and Subgen. Birds, 1855, p. 50.
Cited as a synonym of *Mionectes* CABANIS, 1844.....[*Tyrannidae.*]

Anousella MATHEWS, Birds of Australia, vol. 2, pt. 4, Nov. 1, 1912, p. 412.
Type, *Anous leucocapillus* GOULD=*A. minutus* BOIE.....[*Laridae.*]
(Original designation.)
Anous (ἄνους, foolish)+*ella.* (Mathews, MS.)

Anteliotringa MATHEWS, Birds of Australia, vol. 3, pt. 3, Aug. 18, 1913, p. 274.
Type, *Totanus tenuirostris* HORSFIELD.....[*Scolopacidae.*]
(Original designation and monotypy.)
Ἀντήλιος, eastern+*Tringa* (τρύγγας, a kind of bird). (Mathews, MS.)

Antiurus RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 98.
Type, *Stenopsis maculicaudus* LAWRENCE.....[*Caprimulgidae.*]
(Original designation and monotypy.)
Ἄντιος, different; οὐρά, tail. (Ridgway.)

Anurophasis VAN OORT, Notes Leyden Museum, vol. 32, No. 4, Dec. 30, 1910, p. 211.
Type, *Anurophasis monorthonyx* VAN OORT.....[*Phasianidae?*[4]]
(Monotypy.)

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[1] *Ampelis cinctus* Tschudi, 1843, is preoccupied by *Ampelis cincta* Kuhl, 1820.

[2] See note under *Sagittarius.*

[3] Gray, Cat. Genera and Subgen. Birds, 1855, p. 30, quotes *Anabatoides* as a synonym of *Anabazenops* Lafresnaye, the type of which he gives as *Sitta fusca* Vieillot. This is the first (and figured) species mentioned by Des Murs under *Anabatoides.*

[4] "Nov. gen. Gallidarum."

Apterornis SELYS-LONGCHAMPS, Revue Zool., vol. 11, for October, 1848, p. 293.
Type, *Apterornis solitarius* SELYS.....[*Raphidae*?]
(Subsequent designation, Gray, 1855.)

Ardeotis "Is. Geoffroy" LE MAOUT, Hist. Nat. Oiseaux, 1853, p. 340.
Type, *Otis arabs* "Gmelin" [=Linnaeus, 1758].....[*Otididae.*]
(Monotypy.)
"*Héron* (*Ardea*) et l'*Outarde* (*Otis*)." (Le Maout.)

Arfakornis MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 61.
Substitute name for *Microlestes* MEYER, 1884 (preoccupied).
Type, *Microlestes arfakianus* MEYER.....[*Muscicapidae.*]
(Original designation and monotypy.)
Arfak (mountains, New Guinea)+ὄρνις, a bird. (Mathews, MS.)

Argala T. BROWN, Zoologist's Text-Book, vol. 1, 1832,[1] p. 252, pl. 62, fig. 1.
Type, *Argala gigantea* BROWN [=*Ardea gigantea* FORSTER, 1795?]..[*Ciconiidae.*]
(Monotypy.)

Ariadne[2] A. NEWTON, Ibis, vol. 3, No. 9, January, 1867, p. 128.
Substitute for *Ariana* Mulsant and Verreaux.....[*Trochilidae.*]

Ashbyia NORTH, Agric. Gazette New South Wales, vol. 22, pt. 3, March, 1911, p. 211; MATHEWS, Emu, vol. 12, 1913, pl. E.
Type, *Ephthianura lovensis* ASHBY.....[*Turdidae.*]
(Original designation and monotypy.)
For Edwin Ashby. (North.)

Atalolestris MATHEWS, Birds of Australia, vol. 2, pt. 5, Jan. 31, 1913, p. 500.
Type, *Stercorarius longicaudus* VIEILLOT.....[*Stercorariidae.*]
(Original designation and monotypy.)
(Subgenus of *Stercorarius.*)
Ἀταλός, delicate+*Lestris* (λῃστρίς, piratical.) (Mathews, MS.)

Aurepthianura MATHEWS, Emu, vol. 12, pt. 3, Jan. 1, 1913, p. 205.
Type, *Epthianura aurifrons* GOULD.....[*Turdidae.*
(Subsequent designation, Mathews, 1913.)
Aureus, golden+*Epthianura* (ἐφθός, dressed; οὐρά, tail). (Mathews, MS.)

Austranthus MATHEWS, Austral Avian Record, vol. 2, No. 7, Jan. 28, 1915, p. 123.
Type, *Anthus australis* VIEILLOT.....[*Motacillidae.*
(Original designation and monotypy.)
Australis, southern+*Anthus* (ἄνθος, a small bird). (Mathews, MS.)

Austrartamus MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 114.
Type, *Artamus melanops* GOULD.....[*Artamidae.*]
(Original designation and monotypy.)
Australis, southern+*Artamus* (ἄρταμος, a butcher). (Mathews, MS.)

Austrodicæum MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 60.
Type, *Motacilla hirundinacea* SHAW.....[*Dicaeidae.*]
(Original designation and monotypy.)
Australis, southern+*Dicæum* (δίκαιον, a very small "bird" of India). (Mathews, MS.)

[1] There is another issue, dated 1833, but the text appears to be identical with the above.
[2] Newton writes "Ariana [qu. Ariadne?]."

Austropitta MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 62.
New name for *Coloburis* CABANIS and HEINE, 1860 (not *Colobura* BILLBERG, 1820, nor *Coloburus* DUMÉRIL, 1853).....[*Pittidae.*]
Type, *Pitta strepitans* TEMMINCK=*P. versicolor* SWAINSON.
(Original designation and monotypy.)
Australis, southern+*Pitta*. (Mathews, MS.)

Austrotis MATHEWS, Austral Avian Record, vol. 2, No. 1, Aug. 2, 1913, p. 12.
Type, *Otis australis* GRAY.....[*Otididae.*]
(Original designation and monotypy.)
Australis, southern+*Otis* (*ὠτις*, bustard). (Mathews, MS.)

Austroturnix MATHEWS, Austral Avian Record, vol. 1, No. 8, Mar. 20, 1913, p. 195.
Type, *Hemipodius castanotus* GOULD.....[*Turnicidae.*]
(Original designation.)
Australis, southern+*Turnix*. (Mathews, MS.)

Azuria MAYNARD, Directory Birds Eastern N. A., pt. 9, 1907, p. 238.
Type, *Sylvia rara* WILSON.....[*Mniotiltidae.*]
(Original designation and monotypy.)

Balanosphyra RIDGWAY, Proc. Biol. Soc. Washington, vol. 24, Feb. 24, 1911, p. 34.
Type, *Picus formicivorus* SWAINSON.....[*Picidae.*]
(Original designation.)
Βάλανος, an acorn; *σφῦρα*, a hammer. (Ridgway.)

Bannermania MATHEWS and IREDALE, Ibis, ser. 10, vol. 3, No. 3, July, 1915, p. 578.
Type, *Procellaria hornbyi* GRAY.....[*Procellariidae.*]
(Monotypy.)
For David Armitage Bannerman, 1886– (Mathews, MS.)

Bauharnaisius[1] BONAPARTE, Conspectus Gen. Avium,[2] vol. 1, 1850, p. 95.
Type, *Pteroglossus ulocomus* GOULD=*P. beauharnaesii* WAGLER.[*Ramphastidae.*]
(Monotypy and tautonymy.)

Belchera MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 109.
Type, *Petroica rosea* GOULD.....[*Muscicapidae.*]
(Original designation and monotypy.)
For Charles F. Belcher, 1876– (Mathews, MS.)

Blythoscopus GIEBEL, Thesaurus Orn., vol. 3, 1877, pp. 415, 789.
Lapsus for *Phylloscopus* BOIE.....[*Sylviidae.*]

Boanerges THAYER and BANGS, Mem. Mus. Comp. Zoöl., vol. 40, No. 4, August, 1912, p. 199, pl. 6.
Type, *Boanerges internigrans* THAYER and BANGS.....[*Corvidae.*]
(Original designation and monotypy.)

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[1] *Beauharnaisius* in one edition.

[2] There are two editions of volume 1 of the "Conspectus," differing slightly in the size of type, and easily distinguished by the numerous misprints in one of them. In what I assume to be the first edition the genus *Milvus* (p. 21) is printed *Mllvus; Beauharnaisius* (p. 95) is *Bauharnaisius; Hapalocercus* (p. 185) is *Hepalocercus; Herpsilochmus* (p. 199) is *Herpsilochmus; Fregilus* (p. 388) is *Fregilius*, etc. The method of publication of this work is not very clear. The first part was issued as "Sectio prima" in 1850, and was received by the Paris Academy on or before June 24, 1850. It is noted as "Sect. I." in the Intelligenz Blatt of Serapeum, for June 30, 1850. The second part of the volume was presented at the meeting of the Paris Academy on Feb. 3, 1851. There is some uncertainty as to where the first part ends, probably with page 272, but I am unable to make certain at this time. The final title-page for volume 1 was not issued until after Bonaparte's death, in 1857, and is commonly found pasted to the temporary one in bound copies.

Bolborhynchus BONAPARTE, Remarques Observ. Blanchard Psittacides,[1] April, 1857, p. 6.
Type, *Myiopsitta catharina* BONAPARTE [2].....[*Psittacidae.*]
(Subsequent designation.[3])

Bolbospiza REICHENOW, Die Vögel, vol. 2, 1914, p. 416.
Substitute name for "*Nesospiza*" [4] SALVADORI.....[*Ploceidae.*]

Bostrychia "Reich. (1845?)" [5] GRAY, Genera Birds, vol. 3, 1849 [April, 1847], pp. 565, 566.
Type, *Ibis carunculata* RÜPPELL.....[*Threskiornithidae.*]
(Original designation and monotypy.)

†**Botauroides** SHUFELDT, Trans. Conn. Acad. Arts and Sciences, vol. 19, February, 1915, p. 33.
Type, *Botauroides parvus* SHUFELDT.....[*Ardeidae.*]
(Monotypy.)
Botaurus+Gr. εἶδος, resemblance. (Shufeldt.)

Bowyeria MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 114.
Type, *Collyriocincla boweri* RAMSAY.....[*Prionopidae.*]
(Original designation and monotypy.)
For Thomas Henry Bowyer-Boyer, 1862–1886. (Mathews, MS.)

Broadbentia MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 60.
Type, *Ptilotis flava addenda* MATHEWS.....[*Meliphagidae.*]
(Original designation and monotypy.)
For Kendall Broadbent, 1837–1911. (Mathews, MS.)

Buteaëtos J. F. NAUMANN, Naumannia, vol. 3, 1853, p. 116 (*nomen nudum*); H. F. Moeschler, p. 296.
Type, *Buteo leucurus* NAUMANN.....[*Buteonidae.*]
(Monotypy.)

Cactospiza RIDGWAY, Proc. U. S. Nat. Mus., vol. 19, No. 1116, Mar. 15, 1897, p. 546.
Type, *Cactornis pallida* SCLATER and SALVIN.....[*Fringillidae.*]
(Original designation.)
(Subgenus of *Camarhynchus.*)

Caeruleocantor MAYNARD, Directory Birds Eastern N. A., pt. 9, 1907, p. 236.
Type, *Motacilla cærulescens* GMELIN.....[*Mniotiltidae.*]
(Original designation and monotypy.)

Caleya MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 59.
Type, *Colluricincla rufogaster* GOULD.....[*Prionopidae.*]
(Original designation and monotypy.)
For George Caley, 1770?–1829. (Mathews, MS.)

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[1] This is a repaged reprint of two papers from the Comptes Rendus, vol. 44, 1857 (No. 11, pp. 534–539; No. 12, pp. 595–597), with important additions and changes. It is entitled "Remarques à propos des Observations de M. Émile Blanchard sur les Caractères ostéologiques chez les Oiseaux de la famille des Psittacides, et Tableau des genres de Perroquets disposés en séries parallèles," pp. 1–9, and its receipt was acknowledged by the Academy at the meeting of Apr. 13, 1857.

[2] The type cited by Salvadori (Cat. Birds Brit. Mus., vol. 20, 1891, p. 233) is *Arara aymara* D'Orbigny, a species not in the above paper.

[3] Proc. Biol. Soc. Washington, vol. 28, Nov. 29, 1915, p. 183.

[4] Not *Nesospiza* Cabanis. Salvadori, moreover, proposed the name *Neospiza* (converted into "*Nesospiza*" by Reichenow, Vögel Afrikas, vol. 3, pt. 1, 1904, p. 278), hence the proposed change is unnecessary. *Neospiza* was inadvertently placed in the family Fringillidae in my second supplement.

[5] Reichenbach, Nat. Syst. der Vögel, 1852 (1853), p. xiv, credits the name to "Wagl.," but I have not found it in the works of this author, and the type species was not described until several years after Wagler's death.

Calidris [———?] [1] Allg. Lit.-Zeitung, 1804, vol. 2, No. 168, June 8, 1804, col. 542.
Type, *Tringa calidris* LINNAEUS.....[*Scolopacidae.*]
(Tautonymy.)

Calonectris MATHEWS and IREDALE, Ibis, ser. 10, vol. 3, No. 3, July, 1915, pp. 586, 590, 592.
Type, *Puffinus leucomelas* TEMMINCK.....[*Puffinidae.*]
(Virtual monotypy.)
Καλός, beautiful, fair+*Nectris*. (Mathews, MS.)

Caloperdix BLYTH, Journ. Asiatic Soc. Bengal, vol. 30, No. 2, 1861, p. 193 (note).
Type, *Cryptonyx ocellatus* VIGORS.....[*Phasianidae.*]
(Monotypy.)

Calopicus MALHERBE, Monogr. Picidées, vol. 1, 1861, p. liii.
Type, *Picus flavinucha* GOULD.....[*Picidae.*]
(Original designation and monotypy.)
Calos, beau+*Picus*. (Malherbe.)

Caloptilotis MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 414.
Type, *Ptilotis macleayana* RAMSAY.....[*Meliphagidae.*]
(Original designation and monotypy.)
Καλός, beautiful, fair+*Ptilotis* (πτίλον, feather; οὖς,ὠτός, ear). (Mathews, MS.)

Calorhynchus A. WAGNER, Archiv für Naturgesch., vol. 7, Bd. 2, 1841, p. 98.
Substitute name for *Caloramphus* LESSON, 1839.....[*Capitonidae.*]

Camiguinia MCGREGOR, Philippine Journ. Sci., vol. 2, No. 5, Sect. A, October, 1907, p. 346.
Type, *Camiguinia personata* MCGREGOR[2].....[*Muscicapidae.*]
(Original designation and monotypy.)

Campbellornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 113.
Type, *Ocypterus personatus* GOULD.....[*Artamidae.*]
(Original designation and monotypy.)
For Archibald James Campbell. (Mathews, MS.)

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[1] An anonymous reviewer of Bechstein's Orn. Taschenbuch presents his views on the arrangement of certain genera of Limicolae by means of the following key, in which several new generic names are introduced:

"*Hausteufel, Philomachus.*
Schnabel walzenförmig, allmählig verdünnt, stumpf.
Mittlere und äussere Zehe etwas verbunden.
Tringa pugnax.

Knüssel, Calidris.
Schnabel walzenförmig, gegen die Spitze hin dicker, glatt.
Mittlere und äussere Zehe etwas verbunden.
Tringa calidris, arenaria u. a.

Steinpicker, Cinclus.
Schnabel zusammengedrückt, walzenförmig, gegen die Spitze hin dünner, stumpf, gerade.
Zehen ganz frey.
Tringa Cinclus, alpina, islandica u. a.

Steinwalzer, Arenaria.
Schnabel steigend.
Tringa interpres.

Strandläufer, Tringa.
Schnabel walzenförmig, zusammengedrückt, mit längerer etwas herübergeschlagener, glatter, an der Spitze bucklicher Oberkinnlade.
Tringa Gambetta, Ochropus, pusilla, striata, hypoleucos, Canutus Linn. macularia u. a. auch gehören einige Wasserläufer des Vfs. *Scolopax Totanus* und *fusca* hieher.

Knot. Canutus.
Schnabel länglicht: kegelförmig, stumpf.
Knot der englischen Naturforscher."

[2] The species= *Cyanomyias helenæ* Steere. (See McGregor, Phil. Journ. Sci., vol. 4, 1909, p. 73.

Canaria C. T. Wood, Orn. Guide, [January, 1837], p. 215.
Type, *Canaria varia* Wood, or "Common Canary," a *nomen nudum* here.....[*Fringillidae.*]
(Monotypy.)

Cannabis Blyth, Journ. Asiatic Soc. Bengal, vol. 19, No. 3 (publ. August, or later), 1850, p. 224.
Type, *Fringilla linaria* Linnaeus[1].....[*Fringillidae.*]
(Present designation.)

Canutus [———?] Allg. Lit.-Zeitung, 1804, vol. 2, No. 168, June 8, 1804, col. 542.
Type, "*Knot* der englischen Naturforscher".....[*Scolopacidae.*]
(Monotypy.)
(See note under *Calidris.*)

Capripeda "Verr." Bonaparte, Rivista Contemporanea [Torino], vol. 9, Fasc. 40, February, 1857, p. 215 (p. 9 of reprint); Salvadori, Atti R. Accad. Sci. Torino, vol. 49, 1914, pp. 447–451.
Type, *Caprimulgus natalensis* Smith.....[*Caprimulgidae.*
(Monotypy.)

Carterornis Mathews, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 111.
Type, *Monarcha leucotis* Gould.....[*Muscicapidae.*]
(Original designation and monotypy.)
For Thomas Carter, 1862– (Mathews, MS.)

Cassowara Perry, Arcana, No. 21, September, 1811, text to pl. [82].
Type, *Cassowara eximia* Perry.....[*Casuariidae.*]
(Monotypy.)

†**Cathartornis** L. H. Miller, Univ. Calif. Publ. Bull. Dept. Geology, vol. 6, No. 1, Nov. 28, 1910, p. 14.
Type, *Cathartornis gracilis* Miller.....[*Incertae sedis.*]
(Monotypy.)
Cathartes (καθαρτής, a cleanser)+ὄρνις, bird. (Miller, MS.)

Caudolanius Bianchi, Aves Exped. P. K. Kozlowi, 1899–1901, 1907, p.—.
Type, *Lanius erythronotus* Vigors.....[*Laniidae.*]
(Present (?) designation.)

Cenchris[2] "Boje" C. L. Brehm, Handb. Stuben ... Vögel, 1832, pp. xviii, 323; Gloger, Hand und Hilfsbuch, 1842 [=1841], p. 213.
Type, *Falco tinnunculus* Linnaeus.....[*Falconidae.*]
(Monotypy.)

Cerioclepteс Chapin, Bull. Amer. Mus. Nat. Hist., vol. 34, Oct. 20, 1915, p. 512.
Type, *Cerioclepteс xenurus* Chapin.....[*Indicatoridae.*]
(Monotypy.)
Κηριοκλέπτης, a stealer of honeycombs. (Chapin, MS.)

Cettia Bonaparte, Iconogr. Fauna Italica, vol. 1, 1834 (fasc. 9), text to pl. [29].
Type, *Sylvia cetti* Temminck.....[*Sylviidae.*]
(Original designation.)
(Subgenus of *Sylvia.*)

Chacura Hodgson, Madras Journal Lit. and Science, vol. 5, No. 15, for April, 1837, p. 305.
Type, *Chacura pugnax* Hodgson=*Perdix chukor* Gray.....[*Phasianidae.*]
(Original designation and monotypy.)

[1] The species mentioned are "*Fringilla linaria*, L., v. *Linaria canescens*, Gould," and "*C. minor*," the latter without citation of authority. (Refer also to the names *Cannabia* Billberg, 1828, and *Linophaga* Morris, 1837.)

[2] This doubtless is a slip for *Cerchneis* Boie.

Chelidonia R. BREHM, Naumannia, 1858, p. 231.
Type, *Chelidonia rupestris* [=*Hirundo rupestris* SCOPOLI].....[*Hirundinidae.*]
(Monotypy.)

Chenalopex DUMONT, Dict. Sci. Nat., vol. 8, 1817, p. 393; VIEILLOT, Nouv. Dict. d'Hist. Nat., ed. 2, vol. 24, 1818, p. 132 (see also p. 466, under the word "Panope," and vol. 1, 1816, p. 381).
Type, *Alca impennis* LINNAEUS.....[*Alcidae.*]
(Monotypy.)

Chera[1] GRAY, Gen. Birds, vol. 1, pt. 1, May, 1844, p. [4] of Ploceinae.
Type, *Emberiza progne* BODDAERT.....[*Ploceidae.*]
(Monotypy.)

Chilia SALVADORI, Ibis, ser. 9, vol. 2, No. 7, July, 1908, p. 451.
Type, *Enicornis melanura* GRAY.....[*Furnariidae.*]
(Monotypy.)

Chionophilos PETÉNYI, in C. L. Brehm, Handbuch Stuben ... Vögel, 1832, p. 296; BREHM, Isis, 1842, p. 505.
Type, *Alauda alpestris* LINNAEUS.....[*Alaudidae.*]
(Monotypy.)
(See also *Niphophilos.*)

Chlidonias RAFINESQUE, Kentucky Gazette, vol. 36 (new ser., vol. 1), No. 8, Feb. 21, 1822, [3]; RHOADS, Auk, vol. 29, April, 1912, p. 197.
Type, *Sterna melanops* RAFINESQUE [=*Sterna surinamensis* GMELIN]..[*Laridae.*]
(Monotypy.)

Chloreus KAUP, Nat. Syst., 1829, p. 161.
Type, not mentioned; a *nomen nudum* here.....[*Fringillidae.*]

Chlorochroa[2] SCLATER, Athenaeum, No. 1834, Dec. 20, 1862, p. 811; GRAY, Hand-List Birds, vol. 1, 1869, p. 382.
Type, *Chlorochroa vireonina* SCLATER; a *nomen nudum* here.....[*Vireonidae.*]
(Monotypy.)

Chopis[3] "Verreaux" BONAPARTE, Conspectus Gen. Avium, vol. 1, 1850, p. 425.
Type, "Chopis ater, *Verreaux*" [=*Agelaius chopi* VIEILLOT].....[*Icteridae.*]
(Monotypy.)

Chryserpes W. DE W. MILLER, Bull. Amer. Mus. Nat. Hist., vol. 34, Oct. 20, 1915, p. 517.
Type, *Picus striatus* MÜLLER.....[*Picidae.*]
(Original designation and monotypy.)
Χρύσεος, golden; ἕρπης, creeper. (Miller, MS.)

["*Chrysocephalus*, Swains.," quoted by Waterhouse (Index, 1889, p. 44), is used by Swainson only as a specific name—"*Sericulus Chrysocephalus.*"]

Chrysolophus[4] J. E. GRAY, Illustr. Indian Zoology, vol. 2, No. —, 1833–34, pl. 41, fig. 2.
Type, *Phasianus pictus* LINNAEUS.....[*Phasianidae.*]
(Monotypy.)

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[1] See note under *Hyphantornis.*

[2] This name occurs in a notice of the meeting of the Zoological Society of London for Dec. 9, 1862. In the published Proceedings the bird is described and figured as *Vireo hypochryseus* (Proc. Zool. Soc. London, 1862 (1863), p. 369, pl. 46).

[3] *Chopis* is not adopted by Bonaparte, but cited in the synonymy of *Psarocolius chopi.* If names in synonymy are valid, this one will replace *Gnorimopsar* Richmond=*Aaptus* Richmond (not *Aaptos* J. E. Gray, 1867)=*Aphobus* Cabanis, 1851 (not *Aphobus* Gistel, 1848).

[4] *Chrysolophus* Swainson, 183–, is a member of the Tyrannidae.

Chrysopterus SWAINSON, Classif. Birds, vol. 1, 1836, p. 69.
Type, "our common green woodpecker (*Chrysopterus viridis* Sw.)"...[*Picidae.*]
(Monotypy.)

Chrysothlypis BERLEPSCH, Bericht V. Intern. Orn.-Kongress, 1910 [1911], pp. 1005, 1080.
Type, *Tachyphonus chrysomelas* SCLATER and SALVIN.....[*Tangaridae.*]
(Original designation and monotypy.)

Chrysotrogon RIDGWAY, Bull. U. S. Nat. Mus., No. 50, pt. 5, Nov. 29, 1911, p. 784.
Type, *Trogon caligatus* GOULD.....[*Trogonidae.*]
(Original designation.)
Χρυσός, gold+*Trogon* (τρώγω, I gnaw, I eat). (Ridgway.)

Chubbia MATHEWS, Birds of Australia, vol. 3, pt. 3, Aug. 18, 1913, p. 291.
Type, *Gallinago stricklandi* GRAY.....[*Scolopacidae.*]
(Monotypy.)
For Charles Chubb. (Mathews, MS.)

Cinathisma HULL, Bull. No. 5, Roy. Austral. Orn. Union, Dec. 21, 1915, p. 1; Emu, vol. 15, pt. 3, January, 1916, p. 205, pl. 31, fig. 4.
Type, *Cinathisma cyanoleuca* HULL.....[*Puffinidae.*]
(Monotypy.)

Cinclus [———?] Allg. Lit.-Zeitung, 1804, vol. 2, No. 168, June 8, 1804, col. 542.
Type, *Tringa cinclus* LINNAEUS.....[*Scolopacidae.*]
(Tautonymy.)
(See note under *Calidris.*)

Circobuteo "Hodgson MS." JERDON, Ibis, ser. 3, vol. 1, No. 3, July, 1871, p. 340.
Type, *Buteo plumipes* HODGSON.....[*Buteonidae.*]
(Monotypy.)

Citrinella BONAPARTE, Iconogr. Fauna Italica, vol. 1, 1833 (fasc. 4), text to pl. [37].
Type, *Fringilla citrinella* LINNAEUS.....[*Fringillidae.*]
(Original designation and tautonymy.)
(Subgenus of *Fringilla.*)

Clanga TYZENHAUS, in Adamowicz, Revue et Mag. de Zool., sér. 2, vol. 9, for December, 1857 (1858), p. 604.
Type, *Falco maculatus* GMELIN.....[*Buteonidae.*]
(Tautonymy; *Aquila clanga* Pallas is a synonym.)

Clangocycnus OBERHOLSER, Emu, vol. 8, pt. 1, July 1, 1908, p. 3.
Type, *Cygnus buccinator* RICHARDSON.....[*Anatidae.*]
(Original designation and monotypy.)
(Subgenus of *Olor* Wagler, 1832.)
Κλαγγή, clangor; κύκνος, cygnus. (Oberholser.)

Colcloughia MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 112.
Type, *Hemipodius melanogaster* GOULD.....[*Turnicidae.*]
(Original designation and monotypy.)
For M. J. Colclough. (Mathews, MS.)

Coleia MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 116.
Type, *Merops carunculatus* LATHAM.....[*Meliphagidae.*]
(Original designation and monotypy.)
For C. F. Cole. (Mathews, MS.)

Colombpicus MALHERBE, Nouv. Classif. Picinées,[1] 1850, p. 45.
Type, *Picus dominicensis* VIEILLOT.....[*Picidae.*]
(Monotypy.)
(See also *Leucopicus.*)

Colonia[2] J. E. GRAY, in Griffith, Animal Kingdom, vol. 6, "1829," p. 336.
Type, *Muscicapa colonus* VIEILLOT.....[*Tyrannidae.*]
(Monotypy.)
(Subgenus of *Muscipeta* Cuvier.)

Columbigallus "auct." STREUBEL, in Ersch u. Gruber, Allg. Encycl., sect. 3, vol. 17, 1842, p. 94.
Type, "Columbicrax *Le Vaill.* (Col. carunculata)."[3].....[*Columbidae.*]
(Monotypy.)

Compsothraupis RICHMOND, Proc. Biol. Soc. Washington, vol. 28, Nov. 29, 1915, p. 180. New name for *Lamprotes* SWAINSON, 1837 (not of R. L., 1817).
Type, *Tanagra loricata* LICHTENSTEIN.....[*Tangaridae.*]
(Original designation and monotypy.)
Κομψός, elegant; θραυπίς, a small bird. (Richmond.)

Conigravea MATHEWS, Austral Avian Record, vol. 2, No. 2-3, Oct. 23, 1913. p. 59.
Type, *Colluricincla parvula conigravi* MATHEWS.....[*Prionopidae.*]
(Original designation and monotypy.)
For William Price Conigrave. (Mathews, MS.)

Coquus W. L. SCLATER, Ibis, ser. 10, vol. 2, No. 1, January, 1914, p. 174.
New name for *Oxynotus* SWAINSON, preoccupied.....[*Campephagidae.*]
Type, *Lanius rufiventer* SWAINSON.
(Original designation.)
(See also *Acanthinotus.*)
Coquus=a cook (native name "cusenier"). (Sclater.)

Coragyps "Isid. Geoffroy" LE MAOUT, Hist. Nat. Oiseaux, 1853, pp. 57, 66.
Type, *Vultur atratus* WILSON.....[*Vulturidae.*]
(Monotypy.)

Corinnes "*Less.* 1832" GRAY, Cat. Gen. and Subgen. Birds, 1855, p. 21.
Type, "*Trochilus mesoleucus*, Valen."[4].....[*Trochilidae.*]
(Original designation and monotypy.)

Cormoranus BAILLON, Mém. Soc. roy. d'Emul. d'Abbeville, [sér. 2, vol. 1,] 1833 [1834?], p. 76, note.
Type, *Pelecanus carbo* LINNAEUS.....[*Phalacrocoracidae.*]
(Subsequent designation; Mathews, 1913.)

Cornix KOELREUTER,[4] Novi Comm. Acad. Sci. Imp. Petrop., vol. 11, 1767, p. 435, pl. 15, fig. 7.
Type, "*Cornix* atra; capite, collo pectoreque, flauis".....[*Incertae sedis.*]
(Monotypy.)

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[1] This is a repaged edition of the author's 1849 paper, with additions. It has no title-page, but is dated "Metz, juillet 1850." It is chiefly interesting through the presence of the new generic names *Colombpicus* and *Linneopicus*, and the emendation of *Melampicos* to *Melanopicos*. Malherbe (Monogr. Picidées, vol. 1, p. xlvii) refers to what is probably another edition in the words "dont la deuxième édition, publiée en septembre 1850, diffère par la transformation d'une section en un genre, par les terminations génériques *os* en *us*, ainsi que par quelques autres additions."

[2] This antedates (and should replace) *Copurus* Strickland, 1841, for the same species.

[3] *Columba carunculata* Temminck is an artefact, and Levaillant called it "Columbi-Galline," not "Columbicrax."

[4] Koelreuter is binary, but not binomial, in this paper.

Coryphotriccus RIDGWAY, Proc. Biol. Soc. Washington, vol. 19, Sept. 6, 1906, p. 115.
Type, *Pitangus albovittatus* LAWRENCE.....[*Tyrannidae.*]
(Original designation and monotypy.)
Κορυφή, the crown; τρίκκος, a small bird. (Ridgway.)

Corytholäea HEUGLIN, Orn. Nordost-Afrika's, vol. 1, Abth. 1, 1869, p. 315.
Type, *Sylvia ruppeli* TEMMINCK.....[*Sylviidae.*]
(Monotypy.)
(Subgenus of *Sylvia.*)

Cossyphus "Cuvier" DUMONT, Dict. Sci. Nat., vol. 29, 1823, pp. 260, 261.
Type, *Paradisea tristis* LINNAEUS[1].....[*Sturnidae.*]
(Present designation.)

†**Creccopus** SHUFELDT, Journ. Acad. Nat. Sci. Phila., ser. 2, vol. 9, pt. 3, Oct. 20, 1892, p. 412 (note).
Substitute name for *Creccoides* Shufeldt.....[*Rallidae.*]

Cryptophaga DEGLAND and GERBE, Orn. Eur., ed. 2, vol. 1, 1867, pp. 307, 308.
Emendation of *Crithophaga* Cabanis, 1851.....[*Fringillidae.*]

Cryptoplectron STREUBEL, in Ersch u. Gruber, Allg. Encycl., sect. 3, vol. 16, 1842, p. 291.
Type, *Coturnix erythrorhyncha* SYKES.....[*Phasianidae.*]
(Present designation and virtual monotypy.[2])
(Subgenus or section of *Pseudortygion*, under genus *Perdix.*)

Crypturellus BRABOURNE and CHUBB, Annals and Mag. Nat. Hist., ser. 8, vol. 14, No. 82, October, 1914, p. 322.
Type, *Tinamus tataupa* TEMMINCK.....[*Tinamidae.*]
(Original designation.)

Ctenanas MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 90.
Substitute name for *Leptotarsis* EYTON, 1838 (not *Leptotarsus* GUÉRIN, 1831).....[*Anatidae.*]
Κτείς (κτεν-), a comb+*Anas* (*anas*, a duck). (Mathews, MS.)

Cyanepops REICHENBACH, Handb. Spec. Orn., Scans., 1853, p. 223.
Type, "*Promerops coeruleus* WAGLER"[3].....[*Irrisoridae.*]
(Monotypy.)

Cyanochen "Hartl." BONAPARTE, Comptes Rendus, vol. 43, October, 1856, p. 648.
Type, *Bernicla cyanoptera* RÜPPELL.....[*Anatidae.*]
(Monotypy.)

Cyanocorvus[4] "Dubus" GRAY, Cat. Genera and Subgen. Birds, 1855, p. 148.
Type, "*Cyanocorvus violaceus* DUBUS".....[*Corvidae.*]
(Original designation and monotypy.)

Cyanolæmus STONE, Auk, vol. 24, No. 2, April, 1907, pp. 196, 197.
Type, *Ornismya clemenciæ* LESSON.....[*Trochilidae.*]
(Original designation and monotypy.)
Κυάνεος, blue; λαιμός, throat. (Stone.)

[1] Ten species are enumerated. Gray (1840, 1841, 1855, 1869) has synonymized it under *Acridotheres* in his several works, and the type species (the first mentioned by Dumont) may stand as above.

[2] *Coturnix novae-zelandiae* Quoy and Gaimard also is included in this group, but with a query. *Cryptoplectron* should replace *Microperdix* Gould, 1862.

[3] =*Promerops caeruleus* Shaw? If so, a fictitious bird.

[4] Probably a lapsus for *Cyanocorax*, but it is adopted by Fitzinger (Sitzungsber. K. Akad. Wiss. Wien, vol. 46, Abth. 1, 1863, p. 208), as a subgenus of *Cyanurus* Swainson. Fitzinger's paper is based largely upon Gray's Catalogue of 1855, and follows the misspellings of the latter very closely.

Cyanonympha OBERHOLSER, Proc. U. S. Nat. Mus., vol. 39, No. 1803, Feb. 25, 1911, p. 587.

Type, *Hypothymis superciliaris* SHARPE.....[*Muscicapidae.*]
(Original designation and monotypy.)

Κύανος, cyanos; νύμφη, nymph. (Oberholser.)

Cyanophasis BUTURLIN, Naša ochota, December, 1908, pp. 33, 35.

Type, *Calophasis mikado* OGILVIE-GRANT.....[*Phasianidae.*]
(Original? designation and monotypy.)

Cygnus BARTRAM,[1] Travels through Carolina, etc., 1791, p. —— (London, ed., 1792, p. 292), *nomen nudum;* ZIMMERMANN, in Bartram, Reisen Nord-und Süd Karolina, 1793, p. 291.

Type, "*Cygnus ferus* LINN. The wild swane . . . (Seligm. Cat. IV. T 44.)".....[*Anatidae.*]
(Monotypy.)

†**Cypselavus** GAILLARD, Annales Univ. Lyon, nouv. sér., Sciences, Médecine, fasc. 23, 1908, p. 63.

Type, *Cypselavus gallicus* GAILLARD.....[*Incertae sedis.*]
(Monotypy.)

Dicrorhynchus CARRIKER, Annals Carnegie Mus., vol. 6, No. 2–4, Aug. 29 [=Sept. 7], 1910, p. 571.

Type, *Tetragonops frantzii* SCLATER.....[*Capitonidae.*]
(Original designation and monotypy.)

Δίκροος, bifurcate; ῥύγχος, bill. (Carriker.)

Diomedella MATHEWS, Birds of Australia, vol. 2, pt. 3, Sept. 20, 1912, p. 275.

Type, *Diomedea cauta* GOULD.....[*Diomedeidae.*]
(Original designation and monotypy.)
(Subgenus of *Thalassogeron.*)

Diomedea (Διομήδεια) +*ella.* (Mathews, MS.)

Diopsittaca RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 99.

Type, *Psittacus nobilis* LINNAEUS.....[*Psittacidae.*]
(Original designation.)

Δῖος, noble; ψιττάκη, a parrot. (Ridgway.)

Dipluravis[2] E. STRAND, Societas entomologica [Stuttgart], vol. 25, No. 4, May 21 1910, p. 14.

Substitute name for *Diplura* JERDON, 1864 (not *Diplura* KOCH, 1850).
[*Ciconiidae.*]

Ditelmatias MATHEWS, Birds of Australia, vol. 3, pt. 3, Aug. 18, 1913, p. 282.

Type, *Gallinago hardwickii* GRAY.....[*Scolopacidae.*]
(Original designation and monotypy.)

Δίς, double+*Telmatias* (τέλμα, a pool, swamp+*ias*). (Mathews, MS.)

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[1] Bartram's reference is merely "Cygnus ferus, the wild swan," but Zimmermann gives Linnaeus as the authority for the name, and "*Cygnus ferus*" is, indeed, a synonym of *Anas cygnus* (Syst. Nat., ed. 10, p. 122). The remainder of Zimmermann's citation is wrong, as the plate quoted occurs in Seligmann, vol. 5, pl. 45 (in the edition examined by me), and is reproduced from Edwards, plate 150, not from Catesby. The species is the one now known as *Olor cygnus* (Linnaeus), type of the genus *Olor* Wagler, 1832. At the moment, it looks as if the swans were in for a transfer of names, but it is not at all improbable that some binary author has used *Cygnus* before 1793, and the name may finally rest upon one of the other species.

[2] *Dipluravis* would have priority for this genus, were it not for *Ibis* Lacépède, 1799, *Diplocercus* Jerdon, 1861, and *Pseudotantalus* Ridgway, 1883. It is, therefore, stranded on the beach of synonymy—a warning to entomologists who may be tempted to introduce ornithological terms in obscure places.

Dolichopicos REICHENBACH,[1] Handb. Orn., Scans., 1854, p. 408.
Type, *Picus percussus* TEMMINCK ..... [*Picidae.*]
(Monotypy.)

Dorcadothera HEUGLIN, Nachträge u. Bericht. Orn. Nordost-Afrika's, 1871, p. ccxii (note).
Type, *Falco saqer* [=*Falco sacer* GMELIN (not Forster)] ..... [*Falconidae.*]
(Monotypy.)
(Subgenus of *Falco.*)

Dorothina MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 111.
Substitute name for *Meliphaga* LEWIN (not *Melophagus* LATREILLE, 1802).
Type, *Meliphaga lewini* SWAINSON ..... [*Meliphagidae.*]
(Original designation.)
For Dorothy White (daughter of Henry Luke White). (Mathews, MS.)

Dreptes REICHENOW, Journal für Orn., vol. 62, Heft 3, July, 1914, p. 488.
Type, *Nectarinia thomensis* BOCAGE ..... [*Nectariniidae.*]
(Original designation and monotypy.)

Drioctistes RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 71.
Type, *Thripophaga sclateri* BERLEPSCH ..... [*Furnariidae.*]
(Original designation and monotypy.)
Δρῖος, a copse, thicket; κτίστης, a settler. (Ridgway.)

Dryotomus SWAINSON, Fauna Boreali-Americana, vol. 2, 1831 [=February, 1832] pp. 301, 304.
Type, *Picus martius* LINNAEUS ..... [*Picidae.*]
(Original designation.[2])
(Subgenus of *Picus.*)
Δρυοτόμος, qui quercus vel arbores secat. (Swainson.)

Dulciornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 112.
Type, *Megalurus alisteri* MATHEWS ..... [*Sylviidae.*]
(Original designation and monotypy.)
For Dulcie Marion Mathews, 1894– (Mathews, MS.)

Dyottornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 116.
Type, *Corvus paradoxus* DAUDIN ..... [*Meliphagidae.*]
(Original designation and monotypy.)
For Robert A. Dyott. (Mathews, MS.)

Ecchaunornis RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 97.
Type, *Bucco radiatus* SCLATER ..... [*Bucconidae.*]
(Original designation.)
Εκχαυνόω, I puff up; ὄρνις, a bird. (Ridgway.)

†**Elopteryx** ANDREWS, Geol. Magazine, N. S., Decade 5, vol. 10, No. 5, May, 1913, p. 195, figs. 1, 2.
Type, *Elopteryx nopcsai* ANDREWS ..... [*Steganopodes*?]
(Monotypy.)

Elseya MATHEWS, Birds of Australia, vol. 3, pt. 2, May 2, 1913, p. 125.
Type, *Charadrius melanops* VIEILLOT ..... [*Charadriidae.*]
(Original designation.)
For J. R. Elsey. (Mathews, MS.)

[1] He cites "Bp. zigodatt.," as if named there, but Bonaparte wrote it *Xiphidiopicus* (Consp. Volue. Zygod., p. 11 [=Ateneo Italiano, vol. 2, No. 8, May, 1854, p. 126]).

[2] The type is not *Picus pileatus* Linnaeus, as stated by Hargitt, Cat. Birds Brit. Mus., vol. 18, 1890, p. 514.

Elseyornis MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 87.
Substitute name for *Elseya* MATHEWS (not of Grandidier, 1867)...[*Charadriidae.*]
For J. R. Elsey+ὄρνις, a bird. (Mathews, MS.)

†**Eoceornis** SHUFELDT, Trans. Conn. Acad. Arts and Sci., vol. 19, February, 1915, p. 39.
Type, *Eoceornis ardetta* SHUFELDT.....[*Ardeidae*?]
(Monotypy.)
"Eocene, =Gr. ἠώς, dawn+καινός, recent and Gr. a bird." (Shufeldt.)

Erogas HOGG, Zoologist, vol. 3, No. 35, Nov., 1845, p. 1172.
Substitute name for *Botaurus* STEPHENS, on grounds of purism.....[*Ardeidae.*]
Ἐρωγάς, a heron. (Hogg.)

Erythrina[1] BLYTH, Cat. Birds Mus. Asiatic Soc., 1849 (1852?), p. 118.
Type, *Loxia prasina* SPARRMAN.....[*Ploceidae.*]
(Monotypy.)

Erythrolæma "*Pr. B.* 1854"[2] GRAY, Cat. Genera and Subgen. Birds, 1855, p. 98.
Type, *Columba pulcherrima* SCOPOLI.....[*Treronidae.*]
(Original designation and monotypy.)
(See also *Columbigallus* DES MURS, 1854.[3])

Erythrosoma SWAINSON, Fauna Boreali-Americana, vol. 2, 1831 [=February, 1832], p. 201.
Type, *Setophaga picta* SWAINSON.....[*Mniotiltidae.*]
(Present designation.[4])
(Subgenus of *Setophaga* SWAINSON.)

Erythrothlypis BERLEPSCH, Bericht V. Intern. Orn.-Kongress, 1910 [1911], pp. 1005, 1081.
Type, *Nemosia rosenbergi* ROTHSCHILD=*Dacnis salmoni* SCLATER..[*Tangaridae.*]
(Original designation and monotypy.)

Ethelornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 110.
Type, *Gerygone magnirostris* GOULD.....[*Muscicapidae.*]
(Original designation and monotypy.)
For Ethel Rose White (Mrs. Samuel Albert White). (Mathews, MS.)

Euaquila ACLOQUE, Faune de France, vol. 1, 1900, p. 99.
Type, *Falco chrysaëtos* LINNAEUS.....[*Buteonidae.*]
(Present designation.[5])
(Section of *Aquila Brisson.*)

Eucircus ACLOQUE, Faune de France, vol. 1, 1900, p. 122.
Type, *Falco æruginosus* LINNAEUS.....[*Buteonidae.*]
(Present designation.[6])
(Section of *Circus* Lacépède.)

Eufalco ACLOQUE, Faune de France, vol. 1, 1900, p. 113.
Type, *Falco communis* GMELIN [=*F. peregrinus* TUNSTALL].....[*Falconidae.*]
(Present designation.[7])
(Section of *Falco* Linnaeus.)

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[1] = *Erythura* Swainson, 1837. Not *Erythrina* Brehm, 1828 (Fringillidae).
[2] Gray, List Spec. Birds, vol. 4, Columbae, 1856, 2, gives the authority as "*Pr. B.* in litt."
[3] Listed in Supplement No. 2 (Proc. U. S. Nat. Mus., vol. 35, 1908, p. 601).
[4] *Setophaga miniata* Swainson is also included in this subgenus.
[5] The included species are *Aquila nævia* "Brisson," *A. adalberti* Brehm, *A. imperialis* "Keyserling and Blasius," *A. fulva* (Linnaeus), and *A. chrysaëtos* (Linnaeus).
[6] Included species are *Circus æruginosus* (Linnaeus), *C. "cineraceus"* (Montagu), and *C. swainsonii* A. Smith.
[7] The species enumerated are *Falco sacer* "Brisson," *F. barbarus* Linnaeus, *Falco lanarius* Schlegel, and *F. communis* Gmelin.

Eugallinago MATHEWS, Birds of Australia, vol. 3, pt. 3, Aug. 18, 1913, p. 294.
Type, *Gallinago macrodactyla* BONAPARTE.....[*Scolopacidae.*]
(Monotypy.)
Εὖ, well+*Gallinago* (from *gallina*, a hen). (Mathews, MS.)

Eumeleagris COUES, Key N. A. Birds, ed. 5, vol. 2, December, 1903, p. 727.
Type, *Meleagris ocellatus* [CUVIER] [1].....[*Meleagridae.*]
(Monotypy.)

Eunisus BONAPARTE, Revue et Mag. de Zoologie, sér. 2, vol. 6, No. 10, for October, 1854, p. 538. Substitute name for *Nisus* "Bp."
Type, *Falco sphenurus* RÜPPELL.....[*Buteonidae.*]
(Present designation.[2])

Eupelia TODD, Annals Carnegie Museum, vol. 8, No. 3-4, May 8, 1913, p. 512.
Type, *Columba cruziana* PREVOST and KNIP.....[*Claraviidae.*]
(Original designation and monotypy.)

Euphasia[3] MULSANT and VERREAUX, Hist. Nat. Ois. Mouches, vol. 2, livr. 4, 1876. p. 289.
Name in key, species not mentioned.....[*Trochilidae.*]

Eupodella MATHEWS, Birds of Australia, vol. 3, pt. 1, Apr. 2, 1913, p. 83.
New name for *Eupoda* Brandt, 1845 (not *Eupodes* KOCH, 1835).
Type, *Charadrius veredus* GOULD.....[*Charadriidae.*]
(Original designation.)
Eupoda (εὖ, well; ποὺς (ποδ−), foot)+*ella*. (Mathews, MS.)

Eutelipsitta MATHEWS, Novit. Zool., vol. 18, No. 1, June 17, 1911, p. 10.
Type, *Psittacus chlorolepidotus* KUHL.....[*Loriidae.*]
(Original designation.)
Εὐτελής, cheap, paltry; ψίττα(κος), a parrot. (Mathews, MS.)

Eyramytis MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 366.
Type, *Amytis goyderi* GOULD.....[*Sylviidae.*]
(Original designation and monotypy.)
For Lake Eyre+*Amytis* (Ἄμυτις, a daughter of Astyages). (Mathews, MS.)

Ficophaga "Vieillot" DUMONT, Dict. Sci. Nat., vol. 16, 1820, p. 529.
New name for *Malimbus* VIEILLOT, 1805.....[*Ploceidae.*]

Flammea FOURNEL, Faune de la Moselle, vol. 1, 1836, p. 101 (see Mathews, Austral Avian Record, vol. 1, 1912, p. 104).
Type, *Flammea vulgaris* FOURNEL [=*Strix alba* SCOPOLI].....[*Tytonidae.*]
(Monotypy.)

Fregettornis MATHEWS, Birds of Australia, vol. 2, pt. 1, May 30, 1912, p. 31.
Type, *Procellaria grallaria* VIEILLOT.....[*Procellariidae.*]
(Original designation and monotypy.)
Fregetta+*ornis* (ὄρνις, a bird). (Mathews, MS.)

Fringilloides BUTURLIN. Naša ochota, January, 1910, pp. 119, 122.
Type, *Emberiza melanocephala* SCOPOLI.....[*Fringillidae.*]
(Original designation.)

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[1] "Its characters entitle it to recognition as a subgenus at least, if not a full genus, which may be named *Eumeleagris*." (=*Agriocharis* Chapman, 1896.)

[2] Seven species are mentioned, of which the first, *Nisus toussenellii* "Verr.," is a *nomen nudum* at this place.

[3] Changed to *Eudosia* in vol. 3, pp. 1, 2.

Frugilegus "Lesson" [1] SELYS, Faune Belge, vol. 1, 1842, p. 68.
Type, *Corvus frugilegus* LINNAEUS .....[*Corvidae.*]
(Monotypy and tautonymy.)
(Subgenus of *Corvus.*)

Fruticantor MAYNARD, Directory Birds Eastern N. A., pt. 9, 1907, p. 246.
Type, *Sylvia discolor* VIEILLOT.....[*Mniotiltidae.*]
(Original designation and monotypy.)

Frutiornis MAYNARD, Directory Birds Eastern N. A., pt. 9, 1907, p. 251.
Type, *Sylvia formosa* WILSON.....[*Mniotiltidae.*]
(Monotypy.)

Fulmariprion MATHEWS, Birds of Australia, vol. 2, pt. 2, July 31, 1912, p. 215.
Type, *Pseudoprion turtur crassirostris* MATHEWS.....[*Procellariidae.*]
(Original designation.)
Fulmarus (latinized from fulmar)+*Prion* (πρίων, a saw). (Mathews, MS.)

Gallicolumba [2] HECK, Bilder-Atlas zum Conversations-Lexikon, vol. 1, 1849, p. 434.
Type, "*Gallicolumba cruenta* (*Taf.* 67 *Fig.* 14)" [=*Columba luzonica* SCOPOLI].
[*Claraviidae.*]
(Monotypy.)

Gallinaza "Vieillot" W. S. MACLEAY, Trans. Linn. Soc. Lond., vol. 16, pt. 1, 1829, p. 15 (note).
Type, "*Gallinaza Aura* Vieill." [= *Vultur aura* LINNAEUS].....[*Vulturidae.*]
(Monotypy.)

Garrulus DUMONT, Dict. Sci. Nat., vol. 24, 1822, pp. 184, 185, 186.
Substitute name for *Bombycilla* VIEILLOT, 1808.
Type, *Garrulus europæus* DUMONT (=*Lanius garrulus* LINNAEUS)..[*Ampelidae.*]
(Present designation.)

Gauropicoides MALHERBE, Monogr. Picidées, vol. 1, 1861, p. liii.
Type, *Picus rafflesi* [VIGORS] .....[*Picidae.*]
(Original designation and monotypy.)
"Γαυρος, fier, superbe" [+*Picoides*]. (Malherbe.)

Geocolaptes (Burchell, MS.) SWAINSON, Fauna Boreali-Americana, vol. 2, 1831 (=February, 1832), p. 315, note.
Type, *Picus terrestris* BURCHELL.....[*Picidae.*]
(Original designation and monotypy.)
(Subgenus of *Colaptes.*)

Gilbertornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 110.
Type, *Pachycephala rufogularis* GOULD.....[*Muscicapidae.*]
(Original designation and monotypy.)
For John Gilbert, ——?–1845. (Mathews, MS.)

Glaucostrix "Pr. B. 1854" GRAY, Cat. Genera and Subgen. Birds, 1855, p. 135.
Substitute name for "*Glaux*, Bl. 1848."
Type, *Strix candida* TICKELL [=*S. longimembris* JERDON].....[*Tytonidae.*]
(Monotypy.)

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[1] The only mention of this name I have met with in the works of Lesson is in his Manuel d'Orn., vol. 1, 1828, p. 385, where it is noted as the "nom trivial du corbeau freux." On page 369 of the same volume it is called "*corvus frugilegus.*"

[2] "Die Gattung Hühnertaube, Gallicolumba s. Columbi-Gallina." No authority is given for either name. The species *cruenta* is described and figured, and is said to be "auf den Philippinen." On the basis of this information *Ptegxnas* Reichenbach, 1851 (*Phlægœnas* Bonaparte, 1855; *Phlegœnas* Bonaparte, "1854"; *Phlegoenas* Reichenbach, "1852" [=1853]; *Phlegoœnas* Des Murs, 1854; *Phlogœnas* Sclater, 1865; *Plegoœnas* Des Murs, 1854) will have to be retired in favor of *Gallicolumba.*

Glaux, RYLANDS, Mag. Nat. Hist. [Loudon's], vol. 9, No. 60, April, 1836, p. 179.
Type, *Strix nyctea* LINNAEUS? [1] ..... [*Strigidae.*]

Gnathodon STREUBEL, in Ersch u. Gruber, Allg. Encycl., sect. 3, vol. 16, 1842, pp. 283, 290.
Type, *Perdix marilandica* LATHAM [= *Tetrao virginiana* LINNAEUS]. [*Phasianidae.*]
(Original designation.)
(Section of *Ortyx*, under the genus *Perdix*.)

Gnorimopsar RICHMOND, Proc. U. S. Nat. Mus., vol. 35, No. 1656, Dec. 16, 1908, p. 584 (note).
Substitute for *Aaptus* Richmond (not *Aaptos* J. E. Gray, 1867) ..... [*Icteridae.*]
(See *Chopis*.)
Γνώριμος, well-known; ψάρ, starling. (Richmond.)

Goethalsia NELSON, Smiths. Misc. Coll., vol. 60, No. 3, Sept. 27, 1912, p. 6.
Type, *Goethalsia bella* NELSON ..... [*Trochilidae.*]
(Original designation and monotypy.)
For George Washington Goethals, 1858– (Nelson.)

Goldmania NELSON, Smiths. Misc. Coll., vol. 56, No. 21, July 8, 1911, p. 1.
Type, *Goldmania violiceps* NELSON ..... [*Trochilidae.*]
(Original designation and monotypy.)
For Edward Alphonso Goldman, 1873– (Nelson.)

Grammopsittaca [2] RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 100.
Type, *Psittacula lineola* CASSIN ..... [*Psittacidae.*]
(Original designation.)
Γραμμή, line; ψιττάκη, a parrot. (Ridgway.)

Grantiella MATHEWS, Novit. Zool., vol. 18, No. 1, June 17, 1911, p. 19.
New name for *Entomophila* GOULD, 1838 (not of HORSFIELD, 1824).
[*Meliphagidae.*]
For William Robert Ogilvie-Grant, 1863– +*ella*. (Mathews, MS.)

Graucalus [3] "*L.* (1735)" GRAY, List Gen. Birds, ed. 2, 1841, p. 101.
Type, *Pelecanus carbo* LINNAEUS ..... [*Phalacrocoracidae.*]
(Original designation and monotypy.)
(See *Cormoranus*.)

Graueria HARTERT, Bull. Brit. Orn. Club, vol. 23, No. 145, Nov. 6, 1908, p. 8; Novit. Zool., vol. 16, 1909, p. 334, pl. 14, fig. 2.
Type, *Graueria vittata* HARTERT ..... [*Timaliidae.*]
(Original designation and monotypy.)
For Rudolf Grauer. (Hartert.)

Guracava H. and R. von IHERING, Cat. Fauna Brazileira, vol. 1 (Aves do Brazil),] 1907, p. 271; Revista Mus. Paulista, vol. 9, 1914, p. 414, pl. 4.
Type, *Guracava difficilis* H. and R. Ihering ..... [*Tyrannidae.*]
(Monotypy.)

Gygisterna MATHEWS, Birds of Australia, vol. 2, pt. 4, Nov. 1, 1912, p. 365.
Type, *Sterna sumatrana kempi* MATHEWS ..... [*Laridae.*]
(Original designation and monotypy.)
(Subgenus of *Thalassoica* Reichenbach, 1853.)
Gygis (γύγης, a fabulous bird)+*Sterna* (latinized form of tern). (Mathews, MS.)

[1] May be intended as a substitute name for *Noctua*: the case is rather complicated.
[2] Proves to be a pure synonym of *Bolborhynchus* Bonaparte. (See note under *Bolborhynchus*.)
[3] Emended to *Gracalus* Gray, 1845, and *Graculus* Gray, 1845. Preoccupied by *Graucalus* Cuvier, 1816 (Campephagidae).

Gymnomyza [1] REICHENOW, Journal für Orn., vol. 62, Heft 3, July, 1914, p. 488; Vögel, vol. 2, 1914, p. 473.
Type, *Leptornis aubryana* VERREAUX and DES MURS .....[*Meliphagidae.*]
(Original designation and monotypy.)

Gyrfalco FLEMING, Hist. Brit. Animals, 1828, p. 50.
Substitute name for *Hierofalco* CUVIER, 1816.....[*Falconidae.*]

Hæmatæna [2] BONAPARTE, Iconogr. Pigeons, Livr. 4, 1857, text to "pl. XXVII, fig. 1." [3]
Type, *Columba melanocephala* J. R. FORSTER .....[*Treronidae.*]
(Original designation and monotypy.)

Hæmatornis [4] SCHLEGEL, Handl. Dierk., vol. 1, 1857, p. 448, pl. 7, fig. 88.
Type, *Himantornis haematopus* HARTLAUB.....[*Rallidae.*]

Hallornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 113.
Type, *Malurus cyanotus* GOULD.....[*Sylviidae.*]
(Original designation and monotypy.)
For Robert Hall. (Mathews, MS.)

Hapalopsittaca RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 100.
Type, *Psittacus amazoninus* DES MURS.....[*Psittacidae.*]
(Original designation and monotypy.)
Ἁπαλός, delicate; ψιττάκη, a parrot. (Ridgway.)

Hapolorhynchus [5] REICHENOW, Journal für Orn., vol. 56, Heft 3, July, 1908, p. 488.
Type, *Pseudogerygone albofrontata* GRAY.....[*Muscicapidae.*]
(Original designation and monotypy.)
Ἁπαλός, delicate; ῥύγχος, bill. (Reichenow.)

Harpe MERREM, in Ersch u. Gruber, Allg. Encycl., sect. 1, vol. 1, 1818, p. 258.
Type, "Harpe barbata, der Lämmergeyer".....[*Buteonidae.*]
(Monotypy.)

Harrisornis MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 110.
Type, *Calyptorhynchus halmaturinus* MATHEWS.....[*Cacatoidae.*]
(Original designation.)
For R. Hamlyn Harris+*ornis*. (Mathews, MS.)

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[1] There is a complication here. In 1885 (Standard Nat. Hist., vol. 4, p. 535), Doctor Stejneger introduced the generic name *Leptomyza* in combination with the species "*Leptomyza aubryana.*" As *Leptornis*, the name previously used for the genus, was preoccupied, it was assumed that *Leptomyza* was a substitute name for *Leptornis*, and it was so recorded in my first supplement. The author's act, however, as opposed to his intention, was to propose a new genus for the species *aubryana*. This detail was of little importance until 1914, when Professor Reichenow subdivided the genus *Leptomyza*, restricting this name to the species *samoensis* and *viridis*, while the new name *Gymnomyza* was proposed for *aubryana* alone. The case works out thus: *Leptornis* Hombron and Jacquinot, 1845? (type, *Merops samoensis* Hombron and Jacquinot) proves to be preoccupied; *Leptomyza* Stejneger, 1885 (type, *Leptornis aubryana* Verreaux and Des Murs) is also preoccupied; *Gymnomyza* Reichenow, 1914 (type *aubryana*) is apparently the earliest available name for either group, leaving the genus represented by *samoensis* and *viridis* without a name. For this I propose *Amoromyza* (type, *Merops samoensis* Hombron and Jacquinot).

[2] *Hæmatæna* occurs in the "Conspectus Generum Columbarum" (or p. [8] of the preliminary text matter), issued in livraison 6, and therefore an emendation of *Hæmatæna*. This name was overlooked by Elliot, in his monograph of the genus *Ptilopus* (Proc. Zool. Soc. Lond., 1878, pp. 560-576), and by Salvadori, in his account of the Pigeons (Cat. Birds Brit. Mus., vol. 21, 1893), but is listed under the emended spelling by Waterhouse. It will replace *Spilotreron* Salvadori, 1882.

[3] The plate was never published.

[4] Apparently an unintentional emendation of *Himantornis* Hartlaub. The latter named a bird *Himantornis haematopus*, which Schlegel here calls *Haematornis himantopus*. The name is correctly quoted on p. 481.

[5] Corrected to *Hapalorhynchus*, Reichenow, Journ. für Orn., 1914, p. 292.

Harriwhitea MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 109.
Type, *Menura alberti* BONAPARTE.....[*Menuridae*.
(Original designation and monotypy.)
For Henry Luke White, 1861– (Mathews, MS.)

†**Hebe** SHUFELDT, Journal of Geology, vol. 21, No. 7, October-November, 1913, p. 644.]
Type, *Hebe schucherti* SHUFELDT.....[*Incertae sedis*.[1]]
(Monotypy.)
Hebe, "the goddess of youth and spring of Greek mythology." (Shufeldt.)

Helenægialus MATHEWS, Birds of Australia, vol. 3, pt. 2, May 2, 1913, p. 114.
Type, *Ægialitis sanctæ-helenæ* HARTING.....[*Charadriidae*.]
(Original designation.)
(Subgenus of *Leucopolius* BONAPARTE.)
St. Helena (island)+*Aegialus* (αἰγιαλός, beach, seashore). (Mathews, MS.)

Heliospiza GUNNING, Journal S. African Orn. Union, vol. 3, No. 2, December, 1907, p. 209.
Type, *Heliospiza noomeæ* GUNNING.....[*Ploceidae*.[2]]
(Monotypy.)

Hellmayria POCHE, Zool. Anzeiger, vol. 27, No. 16/17, May 3, 1904, p. 502.
New name for *Pyrrhocorax* VIEILLOT, 1816 (not of MOEHRING, 1758)....[*Corvidae*.]
For Carl Eduard Hellmayr. (Poche.)

Hemicecrops BONAPARTE, Rivista Contemporanea [Torino], vol. 9, fasc. 40, February, 1857, p. 210 (p. 4 of reprint); SALVADORI, Atti R. Accad. Sci. Torino, vol. 49, 1914, pp. 447–451.
Type, *Hirundo dimidiata* SUNDEVALL.....[*Hirundinidae*.]
(Subsequent designation, Sharpe, 1885?)

Hemiellisia NEUMANN, Novit. Zool., vol. 15, No. 1, June 25, 1908, p. 245.
Type, *Calamoherpe newtoni* HARTLAUB.....[*Sylviidae*.]
(Original designation and monotypy.)

Hemigarzetta MATHEWS, Birds of Australia, vol. 3, pt. 6, June 25, 1914, p. 448.
Type, *Herodias eulophotes* SWINHOE.....[*Ardeidae*.]
(Monotypy.)
"Ημισυς(ἡμι–), half+*Garzetta* (Italian *garzetta*, dim. of *garza*, a white heron). (Mathews, MS.)

Hemiptilotis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 127.
New name for *Trichodere* NORTH, 1912 (not *Trichoderes* GMELIN, 1843).....[*Meliphagidae*.]
"Ημισυς(ἡμι–), half+*Ptilotis* (πτίλον, feather; οὖς,ὠτός, ear). Mathews, MS.)

Hemipuffinus IREDALE, Austral Avian Record, vol. 2, No. 1, Aug. 2, 1913, p. 20.
Type, *Puffinus carneipes* GOULD.....[*Puffinidae*.]
(Monotypy.)

Hemisula MATHEWS, Austral Avian Record, vol. 2, No. 2-3, Oct. 23, 1913, p. 55.
Type, *Sula leucogaster rogersi* MATHEWS.....[*Sulidae*.]
(Original designation and monotypy.)
"Ημισυς (ἡμι–), half+*Sula*. (Mathews, MS.)

Hemitarsus "Sw." BONAPARTE, Conspectus Gen. Avium, vol. 1, 1850, p. 263.
Cited as a synonym of *Pycnonotus* "Kuhl".....[*Pycnonotidae*.]

[1] Thought to be related to the Pteroptochidae.
[2] "Fringillidae" according to Gunning, but it has a spurious primary, and is said to be related to *Anomalospiza*.

Heteromirafra C. H. B. GRANT, Bull. Brit. Orn. Club, vol. 31, No. 189, July 10, 1913, p. 114.
New name for *Heteronyx* GRANT, 1908 (preoccupied).....[*Alaudidae.*]

Heteromunia MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 60.
Type, *Amadina pectoralis* GOULD.....[*Ploceidae.*]
(Original designation and monotypy.)
Ἕτερος, different+*Munia* (a native Indian name). (Mathews, MS.)

Heteronyx C. H. B. GRANT, Bull. Brit. Orn. Club, vol. 21, No. 144, July 1, 1908, p. 111.
Type, *Heteronyx ruddi* GRANT.....[*Alaudidae.*]
(Original designation and monotypy.)
(See *Heteromirafra.*)

Heteroprion MATHEWS, Birds of Australia, vol. 2, pt. 2, July 31, 1912, p. 222.
Type, *Heteroprion belcheri* MATHEWS.....[*Procellariidae.*]
(Original designation.)
Ἕτερος, different+*Prion* (πρίων, a saw). (Mathews, MS.)

Homoscolopax MATHEWS, Birds of Australia, vol. 3, pt. 3, Aug. 18, 1913, p. 291.
Type, *Gallinago imperialis* SCLATER.....[*Scolopacidae.*]
(Monotypy.)
Ὁμός, the same, like+*Scolopax* (σκολόπαξ, a large, snipe-like bird). (Mathews, MS.)

Howeavis, MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 111.
Type, *Muscicapa rufifrons* LATHAM.....[*Muscicapidae.*]
(Original designation and monotypy.)
For Frank Ernest Howe. (Mathews, MS.)

Hylobrontes STONE, Auk, vol. 24, No. 2, April, 1907, p. 198.
Type, *Tetrao umbellus* LINNAEUS.....[*Tetraonidae.*]
(Original designation and monotypy.)
Ὕλη, wood, woodland; βρόντης, a thunderer. (Stone.)

Hyloctistes RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 72.
Type, *Philydor virgatus* LAWRENCE.....[*Furnariidae.*]
(Original designation and monotypy.)
Ὕλη, a wood, forest; κτίστης, a settler. (Ridgway.)

Hylopezus RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 71.
Type, *Grallaria perspicillata* LAWRENCE.....[*Formicariidae.*]
(Original designation and monotypy.)
Ὕλη, a wood, forest; πεζός, walking. (Ridgway.)

Hylophylax RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 70.
Type, *Conopophaga nævioides* LAFRESNAYE.....[*Formicariidae.*]
(Original designation and monotypy.)
Ὕλη, a wood, forest; φύλαξ, a watcher, guard, sentinel. (Ridgway.)

Hyloscopus [1] CABANIS and HEINE, Mus. Heineanum, vol. 4, pt. 2, 1863, p. 75.
Type, *Picus nuttallii* GAMBEL.....[*Picidae.*]
(Monotypy.)

Hylospingus NELSON, Smiths. Misc. Coll., vol 60, No. 3, Sept. 27, 1912, p. 18.
Type, *Hylospingus inornatus* NELSON.....[*Fringillidae.*]
(Monotypy.)
Ὕλη=forest, σπίγγος=a small bird. (Nelson.)

Hypaëtos [2] "Geoffr." GRAY, List Gen. Birds, ed. 2, 1841, p. 4.
Cited as a doubtful synonym of *Spilornis*.....[*Buteonidae.*]

[1] Not used here; cited in synonymy of *Dictyopipo nuttalli.*
[2] Written *Hypaëtus* in 1855 (Cat. Gen. and Subgen. Birds, p. 4).

Hyphantornis[1] GRAY, Genera of Birds, vol. 1, pt. 1, May, 1844, p. [1] of Ploceinae.
Type, *Hyphantornis grandis* GRAY.....[*Ploceidae.*]
(Present designation.)[2]

Hyponectes SUNDEVALL, Journal für Orn., vol. 5, Heft 4, 1857, p. 251.
Substitute name for *Spheniscus* BRISSON.....[*Spheniscidae.*]
Ὑπονεω, aquam subeo. (Sundevall.)

Ibilophus "Lesson" BONAPARTE, Comptes Rendus, vol. 43, No. 21, November, 1856, p. 993.
Equivalent to *Lophotibis* REICHENBACH, 1853.....[*Threskiornithidae.*]

Ibis LACÉPÈDE, Tableau Oiseaux, 1799, p. 18; MATHEWS, Auk, vol. 30, 1913, pp. 92-95.
Type, *Ibis candidus* DAUDIN [=*Tantalus ibis* LINNAEUS][3].....[*Ciconiidae.*]
(Tautonymy, and subsequent designation, Mathews, 1913.)
(See also *Dipluravis*.)

Ictiniastur MATHEWS, Birds of Australia, vol. 5, pt. 1, Nov. 5, 1915, p. 146.
Type, *Milvus sphenurus* VIEILLOT.....[*Buteonidae.*]
(Original designation and monotypy.)
(Subgenus of *Haliastur*.)
Ictinia (ικτίνος, a kite)+*Astur* (*astur*, a kind of hawk). (Mathews, MS.)

Idioptilon BERLEPSCH, Proc. Fourth Intern. Orn. Congress (Ornis, XIV), Feb., 1907, p. 356.
Type, *Idioptilon rothschildi* BERLEPSCH.....[*Tyrannidae.*]
(Original designation and monotypy.)
Ἴδιος=singularis; πτίλον=ala. (Berlepsch.)

Inezia CHERRIE, Mus. Brooklyn Inst., Sci. Bull., vol. 1, No. 16, June 30, 1909, p. 390.
Type, *Capsiempis caudata* SALVIN.....[*Tyrannidae.*]
(Original designation.)
For Enriqueta Inez Cherrie, 1898– (Cherrie.)

Iredaleornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 127.
New name for *Heteromyias* SHARPE, 1879 (not *Heteromyia* SAY, 1825).
[*Muscicapidae.*]
For Tom Iredale, 1880– (Mathews, MS.)

Irediparra MATHEWS, Novit. Zool., vol. 18, No. 1, June 17, 1911, p. 7.
Type, *Parra gallinacea* TEMMINCK.....[*Jacanidae.*]
(Original designation.)

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[1] *Hyphantornis*, and also *Chera*, are now invariably quoted as dating from 1849, although duly recorded by A. Wagner in his report on ornithology for 1844 (Archiv Naturgesch., 1845, vol. 2, p. 52). One or both names were mentioned by Rüppell (Syst. Ueb. Vögel Nord-Ost-Afrika's, 1845, p. 67) and Cabanis (Archiv Naturgesch., 1847, vol. 1, p. 331) before 1849, but a recent author has argued that Rüppell's work could not have been published in 1845, owing to the mention of *Chera* in it! The facts are as follows: Part I of Gray's work, issued in May, 1844, included (among other subjects) four unnumbered pages of Ploceinae, where the genera *Chera* and *Hyphantornis* are duly proposed. In part 47, March, 1849, he issued a revised edition of the Ploceinae, extended to six pages, and to insure this and two or more similar revised sheets being preserved by the binder, he indicated in the table of contents those to be retained. The original sheet, dated "May, 1844," was therefore carefully eliminated in binding.

[2] The original *Hyphantornis* contains 28 species, the second edition 33. Nos. 1 to 9 are the same in both editions, but No. 10 ("*H. personata* (Swains.)") is missing in the substituted text of 1849. Nos. 11 to 28 of the original text are the same as Nos. 10 to 27 of 1849. Sharpe (Cat. Birds Brit. Mus., vol. 13, 1890, p. 427) gives the type of the genus as *Oriolus cucullatus* Müller (*O. textor* Gmelin), which is the first species but Gray (Cat. Gen. and Subgen. Birds, 1855, p. 70) designates "Ploceus grandis, *Vieill.*" as the type of *Hyphantornis* "*G. R. Gr.* 1849." The name *grandis* appears to have been first introduced by Gray, 1844 and not by Vieillot. In view of the several irregularities connected with the case, I designate *Hyphantornis grandis* Gray as the type of *Hyphantornis* Gray, 1844.

[3] See Mathews, Auk, vol. 30, 1913, pp. 92-95, for further details. *Ibis* will replace *Pseudotantalus* Ridgway, 1883,

Jabiru "Vieillot" DUMONT, Dict. Sci. Nat., vol. 20, 1821. p. 278.
Type, *Ardea dubia* GMELIN, "et au *jabiru argala* de M. Vieillot."[1] [*Ciconiidae.*]
(Monotypy.)

Jabiru HELLMAYR, Abh. k. Bayer. Akad. Wiss. (II Kl.), vol. 22, Abth. 3, May 20, 1906, p. 711.
Type, *Ciconia mycteria* LICHTENSTEIN.....[*Ciconiidae.*]
(Monotypy.)

Jambotreron "*Pr. B.* 1854,"[2] GRAY, Cat. Genera and Subgen. Birds, 1855, p. 97.
Type, *Columba jambu* GMELIN.....[*Treronidae.*]
(Original designation and monotypy.)

Karua MATHEWS, Austral Avian Record, vol. 2, No. 2-3, Oct. 23, 1913, p. 59.
Type, *Campephaga leucomela* VIGORS and HORSFIELD.....[*Campephagidae.*]
(Original designation and monotypy.)
Karu, an aboriginal name. (Mathews, MS.)

Kempia MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 109.
Type, *Micræca flavigaster* GOULD.....[*Muscicapidae.*]
(Original designation and monotypy.)
For Robin Kemp. (Mathews, MS.)

Kempiella MATHEWS, Austral Avian Record, vol. 2, No. 1, Aug. 2, 1913, p. 12.
Type, *Kempiella kempi* MATHEWS.....[*Muscicapidae.*]
(Original designation and monotypy.)
For Robin Kemp+*ella*. (Mathews, MS.)

Lacustroica NORTH, Victorian Naturalist, vol. 26, No. 9, Jan. 13, 1910. p. 138.
Type, *Lacustroica whitei* NORTH.....[*Meliphagidae.*]
(Monotypy.)

Laletris REICHENOW, Ornith. Monatsber., vol. 14, No. 5, May, 1906, p. 88.
Type, *Garrulus lanceolatus* [VIGORS].....[*Corvidae.*]
(Monotypy.)

Lalocitta REICHENOW, Ornith. Monatsber., vol. 14, No. 5, May, 1906, p. 88.
Type, *Garrulus lidthi* [BONAPARTE].....[*Corvidae.*]
(Monotypy.)

Lamprolophos[3] DES MURS, in Chenu, Encycl. Hist. Nat., Oiseaux, vol. 3, [1853?], pp. 91, 96.
Type, *Upupa varia* BODDAERT.....[*Sturnidae.*]
(Original designation and monotypy.)
Λαμπρος, brilliant; λοφος, huppe. (Des Murs.)

Lanarius DUMONT, Dict. Sci. Nat., vol. 19, 1821, p. 204.
Emendation of *Laniarius* VIEILLOT.....[*Laniidae.*]

Lanarius[4] "Brisson" LESSON, Écho du Monde Savant, sér. 2, vol. 7, No. 25, April 2, 1843, col. 589.
Type, *Lanarius vulgaris* LESSON="*Falco lanarius*, LATHAM".....[*Falconidae.*]
(Monotypy and tautonymy.)

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[1] In vol. 19, 1821, p. 302, Dumont refers to it as "*mycteria argala*" of Vieillot. I have submitted this case to Mr. Hellmayr, who is of the opinion that Dumont's *Jabiru* is not used in a systematic sense.

[2] Gray, List Spec. Birds, vol. 4, Columbae, 1856, p. 2, gives the authority as "*Pr. B. in litt.*"

[3] *Lamprolophos* Reichenbach, 1853, is a member of the Irrisoridae.

[4] As there is some doubt concerning the identity of *Falco lanarius* of the older authors, Lesson's reference is here reprinted: "64e Genre: LANARIUS, Brisson, Ornith., t. I, p. 363 (Tarses très courts): hab. le nord de l'Asie et de l'Europe.—233. *Lanarius vulgaris; Falco lanarius*, Latham; le *Lanier*, Buff., t. I, p. 243; Vieill., Encycl., p. 1232, *Falco stellaris*, Gm., Temm., Man., t. I, p. 20: hab. Asie; de passage en Pologne, Russie, Islande, Hongie."

Leggeornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 113.
Type, *Malurus lamberti* VIGORS and HORSFIELD.....[*Sylviidae.*]
(Original designation and monotypy.)
For William Vincent Legge. (Mathews, MS.)

Leptonyx SWAINSON,[1] Classif. Birds, vol. 2, [July,] 1837, p. 290; Animals in Menageries, [Jan. 1,] 1838, p. 314.
Type, *Leptonyx melanotis* SWAINSON=*Emberizoides melanotis* TEMMINCK. [*Fringillidae.*]
(Monotypy.)

Leptophaethon MATHEWS, Austral Avian Record, vol. 2, No. 2-3, Oct. 23, 1913, p. 56.
Type, *Phaethon lepturus dorothcæ* MATHEWS.....[*Phaëthontidae.*]
(Original designation and monotypy.)
Λεπτός, delicate+*Phaëthon* (Φαέθων, son of Helios). (Mathews, MS.)

Leptophaps REICHENOW, Journal für Orn., vol. 61, Heft 2, April, 1913, p. 401.
Type, *Columba aymara* PRÉVOST and KNIP.....[*Claraviidae.*]
(Monotypy.)

Leucanous MATHEWS, Birds of Australia, vol. 2, pt. 4, Nov. 1, 1912, p. 432.
Type, *Gygis microrhyncha* SAUNDERS.....[*Laridae.*]
(Original designation and monotypy.)
Λευκός, white+*Anous* (ἄνους, foolish). (Mathews, MS.)

Leucopicus "Malherbe" DES MURS, in Chenu, Encycl. Hist. Nat., Oiseaux, vol. 1 [1853?], p. 239.
Type, *Picus dominicanus* VIEILLOT.....[*Picidae.*]
(Monotypy.)
(See *Colombpicus.*)

Leucopsar STRESEMANN, Bull. Brit. Orn. Club, vol. 31, No. 181, Oct. 28, 1912, p. 4; Novit. Zool., vol. 19, 1912, p. 374, pl. 2.
Type, *Leucopsar rothschildi* STRESEMANN.....[*Sturnidae.*]
(Monotypy.)

Leucopterus "Bonap. FITZINGER," Sitzungsber. K. Akad. Wiss. [Wien], vol. 46, Abth. 1, 1863, p. 198.
Lapsus for *Leptopterus* BONAPARTE.....[*Laniidae.*]

Lewinornis MATHEWS, Austral Avian Record, vol. 2, No. 2-3, Oct. 23, 1913, p. 57.
Type, *Sylvia rufiventris* LATHAM.....[*Muscicapidae.*]
(Original designation and monotypy.)
For John William Lewin, 17—?-1818. (Mathews, MS.)

†**Limicolavis** SHUFELDT, Trans. Conn. Acad. Arts and Sci., vol. 19, February, 1915, pp. 55, 56.
Type, *Limicolavis pluvianella* SHUFELDT.....[*Charadriidae*?]
(Monotypy.)
Limus, mud+*colere*, inhabit,+*avis*, bird. (Shufeldt.)

Limnosalus WÜRTTEMBERG, Naumannia, 1857, p. 432.
Type, "*Buteo longipes*, Jard.[=Jerdon] *B. rufinus*, Rüpp." [2].....[*Buteonidae.*]
(Monotypy.)

Limnothlypis[3] STONE, Science, new ser., vol. 40, No. 1018, July 3, 1914, p. 26.
Type, *Sylvia swainsonii* AUDUBON.....[*Mniotiltidae.*]
(Original designation and monotypy.)
Λίμνη, a marshy lake, and θλυπίς, an ancient bird name. (Stone.)

[1] Not *Leptonyx* Swainson, 1832, a genus of Pteroptochidae.
[2] =*Accipiter ferox* S. G. Gmelin.
[3] For *Helinaia* of authors, not of Audubon. The type of *Helinaia*, as fixed by Gray, 1841, is *Motacilla vermivora* Gmelin.

†**Limosavis** SHUFELDT, Trans. Conn. Acad. Arts and Sci., vol. 19, February, 1915, p. 19.
Substitute name for *Graculavus* MARSH [1].....[*Incertae sedis.*[2]]

Linaria BARTRAM, Travels through Carolina, etc., 1791, p. — (London ed., 1792, pp. 289, 297); ZIMMERMANN, in Bartram, Reisen Nord-und Süd-Karolina, 1793 pp. 151, 286; MATHEWS, Auk, 1914, pp. 88–90.
Type, *Tanagra cyanea* LINNAEUS.....[*Fringillidae.*]
(Present designation.[3])

Lineocantor MAYNARD, Directory Birds Eastern N. A., pt. 9, 1907, p. 240.
Type, *Muscicapa striata* FORSTER.....[*Mniotiltidae.*]
(Present designation.[4])

Linneopicus[5] MALHERBE, Nouv. Classif. Picinées,[6] 1850, p. 52.
Type, *Picus herminieri* LESSON.....[*Picidae.*]
(Monotypy.)

Littlera MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 109.
Type, *Muscicapa chrysoptera* QUOY and GAIMARD.....[*Muscicapidae.*]
(Original designation and monotypy.)
For Frank Mervyn Littler. (Mathews, MS.)

Livia DES MURS, in Chenu, Encycl. Hist. Nat., Oiseaux, vol. 6, [1854?], pp. 34, 40.
Type, *Columba livia* LINNAEUS.....[*Columbidae.*]
(Original designation, monotypy, and tautonymy.)

Loddigesia[7] "Gould" BONAPARTE, Conspectus Gen. Avium, vol. 1, 1850, p. 80.
Type, *Trochilus mirabilis* LODDIGES.....[*Trochilidae.*]
(Monotypy.)

Lophaon STREUBEL, in Ersch u. Gruber, Allg. Encycl., sect. 3, vol. 17, 1842, p. 94.
Type, *Columba lophotes* TEMMINCK.....[*Claraviidae.*]
(Monotypy.)

Lophonetta RILEY, Proc. Biol. Soc. Washington, vol. 27, May 11, 1914, p. 100.
Type, *Anas cristata* GMELIN.....[*Anatidae.*
(Original designation.)
Λόφος, crest; νῆττα, a duck. (Riley, MS.)

Lophoptilotis MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 414.
Type, *Ptilotis leadbeateri* MCCOY.....[*Meliphagidae.*
(Original designation and monotypy.)
Λόφος, crest+*Ptilotis* (πτίλον, feather; οὖς, ὠτός, ear). (Mathews, MS.)

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[1] *Graculavus* is regarded as misleading.

[2] Placed in the Limicolae by Doctor Shufeldt.

[3] When the late Doctor Coues delivered "The finishing stroke to Bartram," in 1899, the term "binary" had not been vested with its present significance. Bartram was a binary author, and must be resuscitated for the benefit of *Lucar* and possibly one or two other names. *Linaria* is properly applied here to *Emberiza ciris* Linnaeus and *Tanagra cyanea* Linnaeus, respectively, but as there is a possibility that *Linaria* eventually may be cited from the second edition of Catesby's "Carolina" (1771), where applied to *Tanagra cyanea*, I have made that species the type.

[4] *Sylvia castanea* Wilson is also included.

[5] Also written *Linnæipicus* Bonaparte, 1854; *Linneipicus* Malherbe, 1861; *Linneopicos* Gray, 1855; and *Linnoeipicus* Malherbe, 1861.

[6] See note under *Colombpicus*.

[7] Also *Loddiggesia* Bonaparte, 1854; *Loddigesiornis* Gould, 1861; *Loddiggiornis* Bonaparte, 1854; *Loddigiornis* Bonaparte, 1850.

Lucar[1] BARTRAM, Travels through Carolina, etc., 1791, p. — (London ed., 1792, p. 288); ZIMMERMANN, in Bartram, Reisen Nord-und Süd-Karolina, 1793, p. 284; MATHEWS, Auk, 1914, pp. 88, 91.
Type, *Muscicapa carolinensis* LINNAEUS.....[*Mimidae.*]
(Monotypy.)

Luscinia BARTRAM, Travels through Carolina, etc., 1791, p. — (London ed., 1792, p. 290); ZIMMERMANN, in Bartram, Reisen Nord-und Süd-Karolina, 1793, p. 287; MATHEWS, Auk, 1914, pp. 89, 91.
Type, "Luscinia, s. philomela Americana; the yellow hooded titmouse," a *nomen nudum* here?[2].....[*Incertae sedis.*]
(Monotypy.)

Luscinioides "Bp." REY, Synon. Eur. Brutvögel und Gäste, 1872, p. 208.
Lapsus for *Lusciniopsis* BONAPARTE.....[*Sylviidae.*]
(See *Philomelopsis.*)

Maccoyornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 113.
Type, *Sphenura broadbenti* McCOY.....[*Sylviidae.*]
(Original designation and monotypy.)
For Frederick McCoy, 1823–1899+*ornis*. (Mathews, MS.)

Macgillivrayornis MATHEWS, South Australian Ornith., vol. 1, pt. 2, April, 1914, p. 12; Emu, vol. 15, pt. 2, Oct., 1915, p. 77, pl. 12.
Type, *Macgillivrayornis claudi* MATHEWS.....[*Meliphagidae.*]
(Original designation and monotypy.)
For William David Kerr Macgillivray, 1867– (Mathews, MS.)

Machophilus THIENEMANN, Rhea, Heft I, 1846, p. 117.
Substitute name for *Philomachus*[3].....[*Scolopacidae.*]

Macrodura MATHEWS, Birds of Australia, vol. 3, pt. 3, Aug. 18, 1913, p. 294.
Type, *Gallinago nobilis* SCLATER.....[*Scolopacidae.*]
(Monotypy.)
(Subgenus of *Gallinago* Koch.)
Μακρός, large+*Odura* (ᾠδή, a song; οὐρά, tail). (Mathews, MS.)

Macrorthonyx MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 111.
Type, *Orthonyx spaldingi* RAMSAY.....[*Timaliidae.*]
(Original designation and monotypy.)
Μακρός, large+*Orthonyx* (ὀρθός, straight; ὄνυξ, claw). (Mathews, MS.)

Maculocantor MAYNARD, Directory Birds Eastern N. A., pt. 9, 1907, p. 238.
Type, *Motacilla maculosa* GMELIN.....[*Mniotiltidae.*]
(Original designation and monotypy.)

Magnamytis MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 366.
Type, *Amytornis woodwardi* HARTERT.....[*Sylviidae.*]
(Original designation.)
Magnus, great+*Amytis* (Ἀμυτις, a daughter of Astyages). (Mathews, MS.)

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[1] *Lucar* dates from Bartram, 1791, and displaces *Dumetella* S. D. W., 1837. It is possibly indeterminate on p. —, where the passage reads "Lucar lividus, apice nigra; the cat bird, or chicken bird": but one p. — (pp. 297–298 of the London ed.) he fixes its status by reference to Catesby's "*Muscicapa vertice nigro*," and Zimmermann adds the Linnaean name in parentheses.

[2] In Bartram, 1791 and 1792, this genus is a *nomen nudum*, but Zimmermann amplifies the reference by writing "Luscinia seu philomela americana. *The yellow hooded titmouse.* Die Amerikanische Nachtigall. CATESBY." Catesby did not describe or figure the "American Nightingale," but Edwards (Nat. Hist. vol. 3, p. 121) did, and as Zimmermann was citing his references from Seligmann's work, where the figures and descriptions from Edwards and Catesby are badly mixed, it is not surprising that this is quoted as from Catesby. This particular bird is in need of further investigation, as it is one of the chief references on which *Motacilla calidris* Linnaeus is founded. It requires strong imagination to see in Edwards's plate 121 the bird we now know as *Vireosylva calidris*.
Under *Tringa pugnax* Linnaeus, he adds: "*Machophilus* et *Machetes pugn.* auct."

Mainatus VIEILLOT, Nouv. Dict. Hist. Nat., ed. 2, vol. 18, 1817, p. 410.
Type, *Mainatus major* VIEILLOT [1] ..... [*Graculidae.*]
(Monotypy.)

Malindangia MEARNS, Philippine Journal of Science, vol. 2, No. 5 (Sect. A), October, 1907, p. 355.
Type, *Malindangia mcgregori* MEARNS ..... [*Campephagidae.*]
(Original designation and monotypy.)
For Mount Malindang, habitat of the genus. (Mearns, MS.)

Manopsitta MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 62.
Substitute name for *Opopsitta* SCLATER, 1860, "used in error for *Cyclopsitta* Auct."
Type, *Cyclopsitta coxeni* GOULD ..... [*Cyclopsittacidae.*]
(Original designation and monotypy.)
Manus, the hand; *ψιττα* (*κος*), a parrot. (Mathews, MS.)

Mantellornis MATHEWS, Birds of Australia, vol. 1, pt. 5, Oct. 31, 1911, pp. 249, 255.
Type, *Notornis hochstetteri* MEYER ..... [*Rallidae.*]
(Monotypy.)
For Walter Mantell. (Mathews, MS.)

Maorigerygone MATHEWS and IREDALE, Ibis, ser. 10, vol. 1, No. 3, July, 1913, p. 437.
Type, *Curruca igata* QUOY and GAIMARD ..... [*Muscicapidae.*]
(Original designation.)
Maori+*Gerygone*. (Mathews, MS.)

Maroturnia MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 112.
Type, *Coturnix pectoralis* GOULD ..... [*Phasianidae.*]
(Orignal designation and monotypy.)
Mara, an aboriginal name+*Turnix*. (Mathews, MS.)

Mathewsena IREDALE, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 82.
Substitute name for *Mathewsia* IREDALE (preoccupied by *Matthewsia* SAULCY, 1868) ..... [*Megalornithidae.*]
For Gregory Macalister Mathews, 1876– (Iredale.)

Mathewsia [2] IREDALE. Bull. Brit. Orn. Club, vol. 27, No. 166, Jan. 23, 1911, p. 47.
Type, *Ardea rubicunda* PERRY ..... [*Megalornithidae.*]
(Original designation.)
For Gregory Macalister Mathews, 1876– (Iredale.)

Mattingleya MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 111.
Type, *Pachycephala peninsulæ* HARTERT ..... [*Muscicapidae.*]
(Original designation and monotypy.)
For Arthur H. E. Mattingley. (Mathews, MS.)

Mearnsia RIDGWAY, Bull. U. S. Nat. Mus., No. 50, pt. 5, Nov. 29, 1911, p. 686.
Type, *Chætura picina* TWEEDDALE ..... [*Micropodidae.*]
(Original designation and monotypy.)
For Edgar Alexander Mearns, 1856–1916. (Ridgway.)

Megalopipo SUNDEVALL, Conspectum Avium Picinarum, 1866, p. 4.
Emendation of *Megapicos* MALHERBE, 1849 ..... [*Picidae.*]

†**Megalornis** OWEN, Proc. Zool. Soc. Lond., pt. 11, No. 121, July, 1843, p. 19.
Equivalent to *Dinornis* OWEN ..... [*Dinornithidae.*]

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[1] This is described as "Le *grand mainate* (*mainatus major*). Il ressemble au précédent ['Le mainate de Brisson'] par sa forme et la variété de ses couleurs; mais il est plus grand; sa taille égale celle du *choucas*. Son bec et ses pieds sont jaunes, sans aucune teinte de rougeâtre. Cet oiseau se trouve dans l'île de Hainan en Asie." I do not find the name in the British Museum Catalogue, nor in the recent papers on the birds of Hainan.

[2] This is, in effect, a substitute name for *Antigone* Reichenbach, 1853 (preoccupied by *Antigone* Gray, 1847, in mollusca), but Iredale has designated a different type for his genus.

Megapodargus MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 63.
New name for *Cyphorhina* LESSON, 1843 (not *Cyphirhinus* SCHÖNHERR, 1826).
Type, *Podargus papuensis* QUOY and GAIMARD..... *Podargidae.*]
(Original designation and monotypy.)
Μέγας, large+*Podargus* (πόδαργος, swift-footed). (Mathews, MS.)

Megapsittacus [1] GIGLIOLI, Boll. Soc. Geogr. Italiana, vol. 11, fasc. 5–7, 1874, p. 357.
Type, *Psittacus mauritianus* OWEN.....[*Cacatoidae.*]
(Monotypy.)

Megastictus RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, April 17, 1909, p. 69.
Type, *Myrmeciza margaritata* SCLATER.....[*Formicariidae.*]
(Original designation and monotypy.)
Μέγας, large; στικτός, marked, spotted. (Ridgway.)

Megathelia MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 112.
Type, *Megapodius tumulus* GOULD.....[*Megapodidae.*]
(Original designation and monotypy.)
A "made-up" name. (Mathews, MS.)

Melanococcyx WÜRTTEMBERG, Naumannia, 1857, p. 434 (*nomen nudum*); HEUGLIN, Journal für Orn., vol. 15, 1867, p. 301.[2]
Type, *Melanococcyx levaillanti* WÜRTTEMBERG.....[*Cuculidae.*]
(Monotypy.)

Melanocoryphoides BIANCHI, Bull. Acad. Imp. Sci. St.-Pétersb., sér. 5, vol. 23, No. 3, 1906, p. 222.
Type, *Melancorypha maxima* GOULD.....[*Alaudidae.*]
(Original designation and monotypy.)

Melanopicos MALHERBE, Nouv. Classif. Picinées,[3] 1850, p. 46.
Emendation of *Melampicos* MALHERBE, 1849.....[*Picidae.*]

†**Meleagrops** (Marsh, MS.) SHUFELDT, Auk, vol. 30, No. 1, January, 1913, p. 33.
Type, *Meleagris celer* MARSH.....[*Incertae sedis.*]
(Monotypy.)

Melichneutes REICHENOW, Ornith. Monatsber., vol. 18, No. 10, October, 1910, p. 160.
Type, *Melichneutes sommerfeldi* REICHENOW.....[*Indicatoridae.*]
(Monotypy.[4])

Melloria MATHEWS. Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 114.
Type, "*Cracticus quoyi tunneyi* HARTERT=*C. spaldingi* MASTERS"..[*Laniidae.*]
(Original designation and monotypy.)
For John White Mellor. (Mathews, MS.)

Melomyza MATHEWS, Austral Avian Record, vol. 1, No. 8, Mar. 20, 1913, p. 196.
Type, *Myzomela obscura* GOULD.....[*Meliphagidae.*]
(Original designation and monotypy.)
Anagram of *Myzomela.* (Mathews, MS.)

Melophilus C. L. BREHM, Journal für Orn., vol. 5, 1857, p. 351.
Substitute name for *Melizophilus* LEACH.....[*Sylviidae.*]

Merganas MACGILLIVRAY, Hist. Brit. Birds, vol. 5, 1852, p. 201.
Type, *Mergus albellus* LINNAEUS.....[*Anatidae.*]
(Monotypy.)

[1] This antedates and should supersede *Lophopsittacus* Newton, 1875.
[2] Heuglin leaves the case in uncertainty. He thinks the species is equivalent to "*Cuculus nigricans* Sw.=*C. chalybaeus* Heugl.," but is not certain.
[3] See note under *Colombpicus.*
[4] He thinks *Melignomon robustus* Bates may belong to this genus.

Meropicus MALHERBE, Monogr. Picidées, vol. 1, 1861, p. lüi.
Type, *Picus hirundinaceus* [LINNAEUS].....[*Picidae.*]
(Original designation and monotypy.)
Merops, guêpier+*Picus*. (Malherbe.)

Merula BODDAERT, Table Pl. Enl., 1783, p. 11 (No. 182), p. 16 (No. 258).
Type, "*Merula montana*, LINN. *syst.* VI." [=*Turdus torquatus* LINNAEUS].....[*Turdidae.*]
(Present designation.[1])

Merula BARTRAM,[2] Travels through Carolina, etc., 1791, p. — (London ed., 1792, p. 288); ZIMMERMANN, in Bartram, Reisen Nord-und Süd-Karolina, 1793, p. 284; MATHEWS, Auk, 1914, pp. 88, 90.
Type, *Merula marilandica* ZIMMERMANN [=*Fringilla rubra* LINNAEUS].....[*Tangaridae.*]
(Virtual monotypy.[3])

Merulissima SEEBOHM, Cat. Birds Brit. Mus., vol. 5, 1881, p. 232.
Substitute name for *Semimerula* SCLATER.....[*Turdidae.*]

Mesitornis BONAPARTE, Comptes Rendus, vol. 41, No. 17, October, 1855, p. 651.
Substitute name for *Mesites* I. GEOFFROY[4].....[*Mesitidae.*]

Mesocarbo MATHEWS and IREDALE, Ibis, ser. 10, vol. 1, No. 3, July, 1913, p. 415.
Type, *Carbo sulcirostris* BRANDT.....[*Phalacrocoracidae.*]
(Original designation.)
Μέσος, middle+*Carbo* (*carbo*, a coal). (Mathews, MS.)

Mesospilus[5] SUNDEVALL, Conspectum Avium Picinarum, 1866, p. 116.
Type, *Picus rafflesi* VIGORS.....[*Picidae.*]
(Monotypy.)
(Subgenus of *Picus*.)

Metagraucalus MATHEWS, Austral Avian Record, vol. 2, No. 2-3, Oct. 23, 1913, p. 59.
Type, *Graucalus tenuirostris* JARDINE.....[*Campephagidae.*]
(Original designation and monotypy.)
Μετά, in the midst of, between+*Graucalus* (γράγκαλος, a kind of bird). (Mathews, MS.)

Metallopsar MATHEWS, Austral Avian Record, vol. 2, No. 2-3, Oct. 23, 1913, p. 60.
Type, *Calornis purpurascens* GRAY.....[*Graculidae.*]
(Original designation and monotypy.)
Μέταλλον, metal; ψάρ, starling. (Mathews, MS.)

Micralcyone MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 107.
Type, *Alcyone pusilla halli* MATHEWS.....[*Alcedinidae.*]
(Original designation and monotypy.)
Μικρός, small+*Alcyone* ('Αλκυόνη, wife of Ceÿx). (Mathews, MS.)

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[1] *Merula* (Corvus) *Brachyurus*, LINN. *Gen.* 50. 15" is mentioned on p. 16. Mathews and Iredale (Austral Avian Record, vol. 3, 1915, pp. 38-40) have discussed this case, but failed to fix the type.

[2] A *nomen nudum* with Bartram, but recognizable from Zimmermann, who adds "(Seligm. Cat. III. T. 12)," and this is clearly applicable to *Fringilla rubra* Linnaeus. From portions of Bartram's diary published by Doctor Stone (Auk, 1913, p. 348), it appears that the Summer Redbird of Bartram was the *Piranga erythromelas* Vieillot, and the Sandhill Redbird was *P. rubra* (Linnaeus), quite the reverse of Zimmermann's usage. However, the latter's action is final, and his *Merula marilandica* is equivalent to *Fringilla rubra* Linnaeus.

[3] *Merula flammea*, or the "Sandhill redbird of Carolina," is also cited, but it is a *nomen nudum* with both Bartram and Zimmermann.

[4] *Mesites* of Schönherr, 1838 (Coleoptera), appears to be subsequent to Geoffroy (see Brazil, Revue Franç. d'Orn., vol. 3, 1914, pp. 66-67).

[5] Equivalent to *Gauropicoides* Malherbe, 1861.

Micrartamus MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 114.
Type, *Artamus minor* VIEILLOT.....[*Artamidae.*]
(Original designation and monotypy.)
Μικρός, small+*Artamus* (ἄρταμος, a butcher). (Mathews, MS.)

Microbainopus BIANCHI, Annuaire Musée Zool. Acad. Imp. Sci. St.-Pétersb., vol. 12, No. 1, June, 1907, pp. 70, 73.
Type, *Phœnicura macgrigoriæ* BURTON.....[*Muscicapidae.*]
(Original? designation.)
(Subgenus of *Niltava* HODGSON.)

Micrococcyx RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 99.
Type, *Coccyzus pumilus* STRICKLAND.....[*Cuculidae.*]
(Original designation.)
Μικρός, small; κόκκυξ, a cuckoo. (Ridgway.)

Microphilemon MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 117.
Type, "*Buphaga orientalis* [1] LATHAM (=*Tropidorhynchus citreogularis* GOULD)."
[*Meliphagidae.*]
(Original designation and monotypy.)
Μικρός, small+*Philemon*. (Mathews, MS.)

Microplectron STREUBEL, in Ersch u. Gruber, Allg. Encycl., sect. 3, vol. 16, 1842, p. 291.
Type, "C[*oturnix*] *cambayensis* LATH. TEMM." [2].....[*Phasianidae.*]
(Monotypy.)
(Section of *Coturnix*, under the genus *Perdix*.)
(See also *Rubicola* BLYTH.)

Micropodargus MATHEWS, Austral Avian Record, vol. 2, No. 2-3, Oct. 23, 1913, p. 57.
Type, *Podargus marmoratus* GOULD.....[*Podargidae.*]
(Original designation and monotypy.)
Μικρός, small+*Podargus* (πόδαργος, swift-footed). (Mathews, MS.)

Microptilotis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 116.
Type, *Ptilotis gracilis* GOULD.....[*Meliphagidae.*]
(Original designation and monotypy.)
Μικρός, small+*Ptilotis* (πτίλον, feather; οὖς, ὠτός, ear). (Mathews, MS.)

Microscops BUTURLIN, Naša ochota, November, 1910, pp. 10, 13.
Type, *Strix acadica* GMELIN.....[*Strigidae.*]
(Monotypy.)
(Subgenus of *Cryptoglaux* Richmond.)

Microstilbon TODD, Proc. Biol. Soc. Washington, vol. 26, Aug. 8, 1913, p. 174.
Type, *Microstilbon insperatus* TODD.....[*Trochilidae.*]
(Original designation and monotypy.)

Microtrogon (Goeldi) SNETHLAGE, Bol. Museu Goeldi, vol. 5, No. 1, February, 1908, p. 62; Goeldi, idem, pp. 92, 94.
Type, *Trogon ramonianus* DEVILLE and DES MURS.....[*Trogonidae.*]
(Monotypy.)
(Not *Microtrogon* BERTONI, 1901; see *Chrysotrogon* RIDGWAY.)

Microxenops CHAPMAN, Bull. Amer. Mus. Nat. Hist., vol. 33, Mar. 19, 1914, p. 196.
Type, *Microxenops milleri* CHAPMAN.....[*Furnariidae.*]
(Original designation and monotypy.)
Μικρός, small+*Xenops* (ξένος, strange; ὤψ, appearance). (Chapman, MS.)

[1] Lapsus for *Buceros orientalis* Latham.
[2] This=*Perdix asiatica* Latham

Microzalias MATHEWS and IREDALE, Ibis, ser. 10, vol. 3, No. 3, July, 1915, p. 597.
Type, *Puffinus nativitatis* STREETS.....[*Puffinidae.*]
(Monotypy.)
(Subgenus of *Puffinus* or *Thyellodroma.*)
Μικρός, small+*Zalias* (ζάλη, surf, spray). (Mathews, MS.)

Milligania MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 112.
Type, *Acanthiza robustirostris* MILLIGAN.....[*Sylviidae.*]
(Original designation and monotypy.)
For Alexander William Milligan. (Mathews, MS.)

†**Minerva** SHUFELDT, Trans. Conn. Acad. Arts and Sci., vol. 19, February, 1915, p. 42.
Type, *Aquila antiqua* SHUFELDT.....[*Strigidae.*]
(Monotypy.)
For "The goddess Minerva of Roman mythology." (Shufeldt.)

Morganornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 112.
Type, *Pomatorhinus superciliosus* VIGORS and HORSFIELD.....[*Timaliidae.*]
(Original designation and monotypy.)
For Alexander Matthew Morgan, 1868– (Mathews, MS.)

Morinella BARTRAM,[1] Travels through Carolina, etc., 1791, p. —— (London ed., 1792, p. 292); ZIMMERMANN, in Bartram, Reisen Nord-und Süd-Karolina, 1793, p. 291; MATHEWS, Auk, 1914, pp.89, 91.
Type, *Morinella americana* ZIMMERMANN=*Tringa morinella* LINNAEUS. [*Arenariidae.*]
(Monotypy and tautonymy.)

Motacilloides BUTURLIN, Messager Ornith., vol. 1, No. 2, May, 1910, p. 127.
Type, *Pericrocotus cinereus* LAFRESNAYE.....[*Campephagidae.*]
(Subsequent designation.[2])

Muscicapella BIANCHI, Annuaire Musée Zool. Acad. Imp. Sci. St.-Pétersb., vol. 12, No. 1, June, 1907, pp. 14, 43.
Type, *Nemura hodgsoni* MOORE.....[*Muscicapidae.*]
(Monotypy.)

Myola MATHEWS, Austral Avian Record, vol. 1, No. 8, Mar. 20, 1913, p. 195.
Type, *Ardea pacifica* LATHAM.....[*Ardeidae.*]
(Original designation and monotypy.)
Myola, an aboriginal name. (Mathews, MS.)

Myophonus[3] TEMMINCK, Planches Coloriées, vol. 2, 1822 (livr. 29), text to pl. 170.
Type, *Myophonus metallicus* TEMMINCK.....[*Timaliidae.*]
(Monotypy?)

Myornis CHAPMAN, Auk, vol. 32, No. 4, October, 1915, p. 410.
Type, *Merulaxis senilis* LAFRESNAYE.....[*Pteroptochidae.*]
(Original designation and monotypy.)
Μῦς, mouse; ὄρνις, bird. (Chapman, MS.)

Myrmoderus RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 70.
Type, *Myiothera loricata* LICHTENSTEIN.....[*Formicariidae.*]
(Original designation.)
Μύρμηξ, an ant; δέρω, I flay, cudgel. (Ridgway.)

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[1] A *nomen nudum* with Bartram, 1791 and 1792, but Zimmermann gives the Linnaean equivalent. The name is a synonym of *Arenaria* Brisson.

[2] Otto, Ornith. Monatsber., 1910, p. 152.

[3] *Myiophoneus* is an emendation, and the leaf devoted to the "Genre Myiophone," although marked as appearing in livraison 29, must have been published much later, as Sharpe has already noted (Cat. Birds Brit. Mus., vol. 7, 1883, p. 7). There are several other instances of substituted text in Temminck's work.

Myrmopagis RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 69.
Type, *Myrmothera axillaris* VIEILLOT.....[*Formicariidae.*]
(Original designation and monotypy.)
Μύρμηξ, an ant; παγίς, a trap. (Ridgway.)

Myrmorchilus RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 69.
Type, *Myiothera strigilata* WIED.....[*Formicariidae.*]
(Original designation and monotypy.)
Μύρμηξ, an ant; ὀρχίλος, a wren. (Ridgway.)

Mytisa MATHEWS, Austral Avian Record, vol. 1, No. 8, Mar. 20, 1913, p. 196.
Type, *Diaphorillas howei* MATHEWS.....[*Sylviidae.*]
(Original designation and monotypy.)
Anagram of *Amytis*. (Mathews, MS.)

Nabouroupus[1] BONAPARTE, Notes Orn. Coll. Delattre, [April], 1854, p. 8.
Type, *Lamprotornis fulvipennis* SWAINSON.....[*Sturnidae.*]
(Monotypy.)

Nannopsittaca RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 100.
Type, *Brotogerys panychlorus* SALVIN and GODMAN.....[*Psittacidae.*]
(Original designation and monotypy.)
Νάννος, dwarf; ψιττάκη, a parrot. (Ridgway.)

Nealbatrus MATHEWS, Birds of Australia, vol. 2, pt. 3, Sept. 20, 1912, p. 274.
Type, *Diomedea chlororhynchos* GMELIN.....[*Diomedeidae.*]
(Original designation and monotypy.)
(Subgenus of *Thalassogeron*.)
Νέος, new+*Albatrus*. (Mathews, MS.)

Necrophagus (Blainville) EYDOUX and SOULEYET, Voyage Bonite, vol. 1, 1841, p. 108.
Substitute name for *Chionis* FORSTER.....[*Chionididae.*]

Neochalcites MATHEWS, Austral Avian Record, vol. 1, No. 1, Jan. 2, 1912, p. 7.
Type, *Chrysococcyx basalis mellori* MATHEWS.....[*Cuculidae.*]
(Original designation.)
Νέος, new+*Chalcites* (χαλκῖτις, copper ore). (Mathews, MS.)

Neoclima MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 115.
Type, *Climacteris picumnus* TEMMINCK.....[*Certhiidae.*]
(Original designation and monotypy.)
Νέος, new+*Clima* (cteris). (Mathews, MS.)

Neonanodes MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 279.
Type, *Psittacus chrysogaster* LATHAM.....[*Psittacidae.*]
(Original designation and monotypy.)
Νέος, new+*Nanodes* (νανώδης dwarfish). (Mathews, MS.)

Neonectris MATHEWS, Austral Avian Record, vol. 2, No. 1, Aug. 2, 1913, p. 12.
Type, *Puffinus brevicaudus* GOULD.....[*Puffinidae.*]
(Original designation and monotypy.)
Νέος, new+*Nectris*. (Mathews, MS.)

Neoparadisea VAN OORT, Notes Leyden Mus., vol. 28, No. 1–2, July, 1906, p. 129.[2]
Type, *Neoparadisea ruysi* VAN OORT.....[*Paradisaeidae.*]
(Monotypy.)

[1] This name does not occur in the original paper as published in the Comptes Rendus.
[2] Repaged separates appear to have been published earlier, as the paper is reviewed in the Ornith. Monatsber., June, 1906, 103.

Neophilemon MATHEWS, Austral Avian Record, vol. 1, No. 5. Dec. 24, 1912, p. 117.
Type, *Philedon buceroides* SWAINSON.....[*Meliphagidae.*]
(Original designation and monotypy.)
Νέος, new+*Philemon.* (Mathews, MS.)

Neophloeotomus DABBENE, Anales Mus. Nac. Hist. Nat. Buenos Aires, vol. 27, July 8,[1] 1915, p. 76, fig. 1.
Type, *Phloeotomus schulzi* CABANIS.....[*Picidae.*]
(Original designation.)

Neopisobia MATHEWS, Birds of Australia, vol. 3, pt. 3, Aug. 18, 1913, p. 245.
Type, *Totanus damacensis* HORSFIELD[2] [=*Tringa subminuta* MIDDENDORFF]. [*Scolopacidae.*]
(Monotypy.)
(Subgenus of *Pisobia* BILLBERG.)
Νέος, new+*Pisobia* (πίσσος, moist land; βιόω, to live). (Mathews, MS.)

Neopœphila MATHEWS, Austral Avian Record, vol. 1, No. 8, Mar. 20, 1913, p. 196.
Type, *Pœphila belcheri* MATHEWS.....[*Ploceidae.*]
(Original designation and monotypy.)
Νέος, new+*Poephila* (πόα, grass; φιλεῖν, love). (Mathews, MS.)

Neopsephotus MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 279.
Type, *Euphema bourkii* GOULD.....[*Psittacidae.*]
(Original designation and monotypy.)
Νέος, new+*Psephotus.* (Mathews, MS.)

Neosericornis MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 353.
Type, *Muscicapa lathami* STEPHENS.....[*Sylviidae.*]
(Original designation and monotypy.)
Νέος, new+*Sericornis* (σηρικός silken; ὄρνις, bird). (Mathews, MS.)

Neosittella MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 114.
Type, *Sittella striata* GOULD.....[*Sittidae.*]
(Original designation and monotypy.)
Νέος, new+*Sittella* (σίττη, a kind of woodpecker+*ella*). (Mathews, MS.)

Neospilura MATHEWS, Birds of Australia, vol. 3, pt. 3, Aug. 18, 1913, p. 293.
Type, *Gallinago solitaria* HODGSON.....[*Scolopacidae.*]
(Original designation.)
Νέος, new+*Spilura* (σπίλος, a spot; οὐρά, tail). (Mathews, MS.)

Neostrepera MATHEWS, Austral Avian Record, vol. 1, No. 8, Mar. 20, 1913, p. 196.
Type, *Strepera arguta* GOULD.....[*Corvidae.*]
(Original designation and monotypy.)
Νέος, new+*Strepera.* (Mathews, MS.)

Neosuthora HELLMAYR, in Wytsman's Genera Avium, pt. 18, 1911, p. 74.
Type, *Suthora davidiana* SLATER.....[*Paridae.*]
(Original designation.)

Nesofregetta MATHEWS, Birds of Australia, vol. 2, pt. 1, May 30, 1912, p. 31.
Type, *Fregetta mœstissima* SALVIN.....[*Procellariidae.*]
(Original designation.)
Νῆσος, island+*Fregetta.* (Mathews, MS.)

Nesomalurus MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 59.
Type, *Malurus edouardi* CAMPBELL.....[*Sylviidae.*]
(Original designation and monotypy.)
Νῆσος, island+*Malurus* (μαλακός, soft; οὐρά, tail). (Mathews, MS.)

[1] Date of this paper.
[2] *T. damacensis* of Horsfield (not of Mathews and recent authors) = *Tringa ruficollis* Pallas, 1776 (see Hartert, Novit. Zool., vol. 23, 1916, p. 92).

Nesomiro MATHEWS and IREDALE, Ibis, ser. 10, vol. 1, No. 3, July, 1913, p. 440.
Type, *Miro traversi* BULLER.....[*Muscicapidae.*]
(Original designation.)
Νῆσος, island+*Miro*. (Mathews, MS.)

Nesopardalotus MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 115.
Type, *Pardalotus quadragintus* GOULD.....[*Dicaeidae.*]
(Original designation and monotypy.)
Νῆσος, island+*Pardalotus* (παρδαλωτός, spotted like the leopard). (Mathews, MS.)

Nesophlox RIDGWAY, Proc. Biol. Soc. Washington, vol. 23, Apr. 19, 1910, p. 55.
Type, *Trochilus evelynæ* BOURCIER.....[*Trochilidae.*]
(Original designation.)
Νῆσος, island; φλόξ, a flame. (Ridgway.)

Nesoptilotis MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 60.
Type, *Ptilotis flavigula* GOULD.....[*Meliphagidae.*]
(Original designation and monotypy.)
Νῆσος, island+*Ptilotis* (πτίλον, feather; οὖς, ὠτός ear). (Mathews, MS.)

Nesozosterops MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 451.
Type, *Zosterops strenua* GOULD.....[*Zosteropidae.*]
(Original designation and monotypy.)
Νῆσος, island+*Zosterops* (ζωστήρ, a girdle; ὤψ, eye). (Mathews, MS.)

Niphophilos PETÉNYI, in Brehm, Handb. Stuben . . . Vögel, 1832, p. 296.
Substitute for *Chionophilos* PETÉNYI.....[*Alaudidae.*]
(See *Chionophilos*.)

Noctua S. G. GMELIN, Novi Comm. Acad. Sci. Imp. Petrop., vol. 15, 1771, p. 447, pl. 12.
Type, *Noctua minor* "BRISSON"[1] S. G. GMELIN [=*Strix flammea* PONTOPPIDAN]. [*Strigidae.*]
(Monotypy.)

Nomadites "Peteniz"[2] GRAY, List Genera Birds, ed. 2, 1841, p. 54.....[*Sturnidae.*]
Cited as a synonym of *Pastor* TEMMINCK.

Nomusia "Heugl. M. S. (1859)" HEUGLIN, Orn. Nordost-Afrika's, vol. 2, 1873, p. 994.[3]
Not adopted; cited as a synonym of *Hemiparra* SALVADORI.....[*Charadriidae.*]

Northiella MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 276.
Type, *Platycercus hæmatogaster* GOULD.....[*Psittacidae.*]
(Original designation.)
For Alfred John North. (Mathews, MS.)

Northipsitta MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 127.
New name for *Spathopterus* NORTH, 1895 (not *Spathoptera* SERVILLE, 1835). [*Psittacidae.*]
For Alfred John North. (Mathews, MS.)

Notiœnas RIDGWAY, Proc. Biol. Soc. Washington, vol. 28, May 27, 1915, p. 106.
Type, *Columba maculosa* TEMMINCK.....[*Columbidae.*]
(Original designation and monotypy.)
Νότιος, southern; οἰνάς, a wild pigeon. (Ridgway.)

[1] Although Gmelin credits the name *N. minor* to "Brisson," the species described and figured here is not the one described by Brisson.

[2] Gray quotes this name as of "Peteniz (183-?)." I have not been able to ascertain whether Petényi ever published the name. See also Hermann, Aquila, vol. 3, 1896, p. 158.

[3] Finsch and Hartlaub (Decken's Reis. O.-Afr., vol. 4, 1870, p. 641) had previously quoted this name from Heuglin's MS., as "*Nonnusia*," under the genus *Limnetes*.

Notiomystis RICHMOND, Proc. U. S. Nat. Mus., vol. 35, No. 1656, Dec. 16, 1908, p. 634 (note).
New name for *Pogonornis* GRAY, 1846 (not *Pogonornis* BILLBERG, 1828).
Type, *Meliphaga cincta* DUBUS.....[*Meliphagidae.*]
(Monotypy.)
Νότιος, southern; μύστις, one initiated. (Richmond.)

Notofalco MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 56.
Type, *Falco subniger* GRAY.....[*Falconidae.*]
(Original designation and monotypy.)
Νότος, the south+*Falco* (*falco*, a falcon). (Mathews, MS.)

Nycthemerus SWAINSON, in Murray, Encycl. of Geography, 1834, p. ——;[1] Amer. ed. of 1837, vol. 1, p. 271, fig. 80.
Type, *Nycthemerus argentatus* SWAINSON=*Phasianus nycthemerus* LINNAEUS. [*Phasianidae.*]
(Monotypy and tautonymy.)

Nyctiphrynus BONAPARTE, Ann. Sci. Nat., sér. 4, vol. 1, 1854, p. 139 (*nomen nudum*); Rivista Contemporanea [Torino], vol. 9, fasc. 40, February, 1857, p. 215 (p. 9 of reprint); Salvadori, Atti R. Accad. Sci. Torino, vol. 49, 1914, pp. 447–451.
Type, *Caprimulgus ocellatus* TSCHUDI.....[*Caprimulgidae.*]
(Subsequent designation, Salvadori, 1914; Oberholser, 1914.[2])

Nyctipolus RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 98.
Type, *Caprimulgus nigrescens* CABANIS.....[*Caprimulgidae.*]
(Original designation.)
Νυκτιπόλος, roaming by night. (Ridgway.)

Nyctiprogne BONAPARTE, Ann. Sci. Nat., sér. 4, vol. 1, 1854, p. 139 (*nomen nudum*); Rivista Contemporanea [Torino], vol. 9, fasc. 40, February, 1857, p. 215 (p. 9 of reprint); Salvadori, Atti R. Accad. Sci. Torino, vol. 49, 1914, pp. 447–451.
Type, *Caprimulgus leucopygius* SPIX.....[*Caprimulgidae.*]
(Monotypy.)

Nyctivociferator W. H. Y., Mag. Nat. Hist. [Loudon's], vol. 7, No. 44, December, 1834, p. 636.
Substitute name for *Caprimulgus* LINNAEUS.....[*Caprimulgidae.*]
(See also *Vociferator* W. H. Y., 1834.)

Oberholseria RICHMOND, Proc. Biol. Soc. Washington, vol. 28, Nov. 29, 1915, p. 180.
New name for *Oreospiza* RIDGWAY, 1896 (not of KEITEL, 1857)..[*Fringillidae.*]
For Harry Church Oberholser, 1870– (Richmond.)

Odontorchilus RICHMOND, Proc. Biol. Soc. Washington, vol. 28, Nov. 29, 1915, p. 180.
New name for *Odontorhynchus* PELZELN, 1868 (not *Odontorynchus* LEACH, 1830).
Type, *Odontorhynchus cinereus* PELZELN.....[*Troglodytidae.*]
(Original designation and monotypy.)
Ὀδούς (ὀδόντος), tooth; ὀρχίλος, wren. (Richmond.)

†**Odontornis** OWEN, Quart. Journ. Geol. Soc., vol. 29, pt. 1, 1873, p. 521 (note).
Equivalent to *Odontopteryx* OWEN[3].....[*Incertae sedis.*]

Odurella MATHEWS, Birds of Australia, vol. 3, pt. 3, Aug. 18, 1913, p. 294.
Type, *Scolopax brasiliensis* SWAINSON.....[*Scolopacidae.*]
(Monotypy.)
(Subgenus of *Gallinago.*)
Odura (ᾠδή, a song; οὐρά, tail)+*ella*. (Mathews, MS.)

[1] Original edition not seen.
[2] Gray (Hand-List, vol. 1, 1869, p. 59) restricted the genus to *C. ocellatus* in 1869.
[3] "I should have preferred the term *Odontornis* for my genus, but it is bespoke for Marsh's subclass."

Oenopsittacus REICHENOW, Journal für Orn., vol. 61, Heft 2, April, 1913, p. 401.
Type, *Chalcopsitta rubiginosa* BONAPARTE.....[*Loriidae.*]
(Monotypy.)

Ognorhynchus [1] BONAPARTE, Remarques Observ. Blanchard Psittacides, April, 1857, p. 6.[2]
Type, *Conurus icterotis* MASSENA and SOUANCÉ.....[*Psittacidae.*]
(Original designation and monotypy.)

Olivetra "Gould" SCHINZ, Eur. Fauna, vol. 1, 1840, p. 430; REY, Synon. Eur. Brutvögel und Gäste, 1872, p. 216.
Type, *Olivetra salicaria* "GOULD"[3].....[*Sylviidae.*]
(Monotypy.)

Onychoramphus [4] HARTLAUB, Revue et Mag. de Zool., sér. 2, vol. 1, 1849, pl. 14, figs. 2, 3.
Emendation of *Onychognathus* HARTLAUB, 1849 .....[*Sturnidae.*]

Onychospiza [5] "Bp." REY, Synon. Eur. Brutvögel und Gäste, 1872, p. 216.
Emendation of *Onychospina* BONAPARTE, 1856.....[*Fringillidae.*]

Oreoibis CHAPMAN, Bull. Amer. Mus. Nat. Hist., vol. 31, Aug. 6, 1912, p. 235, pls. 23, 24.
Type, *Oreoibis akleyorum* Chapman.....[*Threskiornithidae.*]
(Original designation and monotypy.)
Ὄρος (ὄρεος), mountain; ἶβις, the ibis. (Chapman, MS.)

Oreomyias BERLEPSCH, Proc. Fourth Intern. Orn. Congress (Ornis, XIV), February, 1907, pp. 486, 491.
Type, *Pogonotriccus plumbeiceps* LAWRENCE.....[*Tyrannidae.*]
(Original designation and monotypy.)
(See *Oreotriccus.*)

Oreornis VAN OORT, Notes Leyden Museum, vol. 32, No. 4, Dec. 30, 1910, p. 214.
Type, *Oreornis chrysogenys* VAN OORT.....[*Meliphagidae.*]
(Monotypy.)

Oreospiza KEITEL, Verz. Europäischen Vögel, 1857, p. 8; Rey, Synon. Eur. Brutvögel und Gäste, 1872, p. 75.
Type, [*Fringilla*] *nivalis* [LINNAEUS] .....[*Fringillidae.*]
(Present designation.[6])

Oreotriccus RICHMOND, Proc. Biol. Soc. Washington, vol. 28, Nov. 29, 1915, p. 180.
New name for *Oreomyias* Berlepsch, 1907 (not of Reichenow, 1902).[*Tyrannidae.*]
Ὄρος (ὄρεος), mountain; τρίκκος, a small bird.

Origmella MATHEWS, Austral Avian Record, vol. 2, No. 4, Dec. 29, 1913, p. 76.
New name for *Origma* GOULD, 1838 (not *Orygma* MEIGEN, 1830).....[*Sylviidae.*]

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[1] Does not occur in the original paper, published in Comptes Rendus. Should replace *Gnathosittaca* Cabanis, 1864 (see Oberholser, Smiths. Misc. Colls., vol. 48, 1905, p. 61).

[2] For the benefit of those who do not have access to the reprint the paragraph in which *Ognorhynchus* appears is here reproduced: "PSITTACARA, *Bp. ex Spix*, finalement ferme la série des vrais *Aratis*, mais ne compreud plus que *nobilis* et *hahni*, car les autres espèces sont déjà des *Conurés* sans nudité aux joues. On pourrait les isoler comme *Ognorhynchus*, Bp. (type *icterotis*, Massena); mais nous préférons pour le moment les réunir aux *Evopsitta*, premier genre des *Conurés*, et auquel, quoique très-nombreux, il faudra encore ajouter une *Evopsitta brasiliensis.*" (See note under *Bolborhynchus.*)

[3] Lapsus for *Salicaria olivetorum* Gould. This case is similar to that of *Hæmatornis.*

[4] Heuglin writes it "*Onychorhamphus*" (Nachtr. u. Bericht. Orn. Nordost-Afrika's, 1871, p. CCL).

[5] Not *Onychospiza* Prjevalsky, 1876 (=*Onychostruthus* Richmond).

[6] Keitel lists two species: "*Oreospiza* nivalis, alpicola, leucura" (the "Schnee-*Spornfink*, Weissschwänziger"), and "aretoa s. Gebleri" (the "Grauschwänziger Spornfink"). The name *Oreospiza* probably originated at an earlier date, since Bonaparte (Conspectus, vol. 1, 1850, p. 538) cites "*Orospiza? Aliq.*," as a synonym of *Montifringilla;* other authors have credited *Oreospiza* to Gloger. The latter introduced *Geospiza* for this species in "1842" [=1841].

Oropezus RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 70.
Type, *Grallaria rufula* LAFRESNAYE.....[*Formicariidae.*]
(Original designation and monotypy.)
'Ορος, mountain; πεζός, walking. (Ridgway.)

Oroscirtetes REICHENOW, Die Vögel, vol. 2, 1914, p. 578.
Type, *Turdus erythrogaster* VIGORS [1] [=*Petrocincla rufiventris* JARDINE and SELBY].....[*Turdidae.*]
(Monotypy.)

Orthopsittaca RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 99.
Type, "*Psittacus manilatus* BODDAERT (*P. makawaunna* GMELIN)." [*Psittacidae.*]
(Original designation and monotypy.)
'Ορθός, straight; ψιττάκη, a parrot. (Ridgway.)

Orthorynchus [2] "Horsfield" SWAINSON, Zool. Illustr., vol. 1, No. 1, October, 1820, text to pl. 2.
Type, *Sitta frontalis* Swainson.....[*Sittidae.*]

Otocorydopsis BIANCHI, Bull. Acad. Imp. Sci. St.-Pétersb., sér. 5, vol. 25, No. 1–2, January, 1907, p. 29.
Type, *Otocoris berlepschi* HARTERT.....[*Alaudidae.*]
(Monotypy.)

Owenavis MATHEWS, Austral Avian Record, vol. 1, No. 1, Jan. 2, 1912, p. 3.
Type, *Chalcites osculans* GOULD.....[*Cuculidae.*]
(Original designation and monotypy.)
For Richard Owen Mathews, 1892– (Mathews, MS.)

Pachyrhinchus LHERMINIER, Mém. Soc. Linn. Paris, vol. 6, 1827, p. 74.
New name for *Dromas* PAYKULL (type, *Pachyrhinchus bicolor* LHERMINIER= *Dromas ardeola* PAYKULL).....[*Dromadidae.*]

Pagoa MATHEWS, Birds of Australia, vol. 3, pt. 1, Apr. 2, 1913, pp. 82, 98.
Type, *Charadrius geoffroyi* WAGLER.....[*Charadriidae.*]
(Original designation and monotypy.)
Pago, a Lapp name (ex Brisson, Orn., vol. 5, p. 64). (Mathews, MS.)

Pagolla MATHEWS, Birds of Australia, vol. 3, pt. 1, Apr. 2, 1913, p. 83. New name for *Ochthodromus* REICHENBACH, 1853 (not *Ochthedromus* LECONTE, 1848).
Type, *Charadrius wilsonia* ORD.....[*Charadriidae.*]
(Monotypy.)
Pago (see under *Pagoa*). (Mathews, MS.)

†**Palaeobonasa** SHUFELDT, Journal of Geology, vol. 23, No. 7, October–November, 1915, p. 633.
Substitute name for *Gallinuloides* EASTMAN.....[*Tetraonidae.*[3]]
Παλαιός, ancient; βόνασος, a wild bull. (Shufeldt.)

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[1] Not *Turdus erythrogaster* Boddaert, 1783.

[2] Not adopted by Swainson, who cites it as a synonym, "Orthorynchus frontalis. *Horsfield in Linn. Trans.*," and in his account of the bird says: "I discovered the species had already been included in the Doctor's account of the birds of Java, presented to the Linnæan Society, where he has described it under the name of *Orthorynchus frontalis.*" Horsfield's paper was read at the meeting of the Linnaean Society held Apr. 18, 1820, and was published in its transactions (vol. 13, pt. 1, May, 1821), but the generic name *Orthorynchus* does not occur. In the "Addenda et corregenda" to volume 1 of Swainson's work appears the line "erase Orthorynchus frontalis, Horsfield in Linn. Trans."

[3] Originally placed in the family Rallidae; later thought to represent a new family, Gallinuloididae, in the vicinity of the Cracidae, but Doctor Shufeldt says it "was a true grouse," near *Bonasa*. The name *Palaeobonasa* is given because *Gallinuloides* is "misleading."

†**Palaeocasuarius** "Forbes" ROTHSCHILD, Extinct Birds, 1907, p. 219.
Type, *Palaeocasuarius haasti*[1] "Forbes" ROTHSCHILD.....[*Dinornithidae.*]
(Original designation.)

†**Palæolestes** DE VIS, Annals Queensland Museum, No. 10, Nov. 1, 1911, pp. 15, 17.
Type, *Palæolestes gorei* DE VIS.....[*Incertae sedis.*[2]]
(Monotypy.)

†**Palæophasianus** SHUFELDT, Bull. Amer. Mus. Nat. Hist., vol. 32, Aug. 4, 1913, p. 291.
Type, *Palæophasianus meleagroides* SHUFELDT.....[*Incertae sedis.*]
(Monotypy.)
Παλαιός, ancient+*φασιανός*, a pheasant. (Shufeldt.)

Pallenia BONAPARTE, Rivista Contemporanea [Torino], vol. 9, fasc. 40, February, 1857, p. 212 (p. 6 of reprint); SALVADORI, Atti R. Accad. Sci. Torino, vol. 49, 1914, pp. 447–451.
Type, *Cypselus gigantea* TEMMINCK.....[*Micropodidae.*]
(Subsequent designation; Gray, 1869.[3])

Paludipasser NEAVE, Bull. Brit. Orn. Club, vol. 25, No. 155, Nov. 30, 1909, p. 25, Ibis, 1910, p. 251, pl. 3.
Type, *Paludipasser locustella* NEAVE.....[*Ploceidae.*]
(Original designation and monotypy.)

Paragraucalus MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 58.
Type, *Ceblepyris lineatus* SWAINSON.....[*Campephagidae.*]
(Original designation and monotypy.)
Παρά, beside+*Graucalus* (*γράγκαλος*, a kind of bird). (Mathews, MS.)

†**Paraortyx** GAILLARD, Annales Univ. Lyon, nouv. sér., Sciences, Médecine, fasc. 23, 1908, p. 104.
Type, *Paraortyx lorteti* GAILLARD.....[*Phasianidae.*]
(Present designation.[4])

Paraptilotis MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 414.
Type, *Meliphaga fusca* GOULD.....[*Meliphagidae.*]
(Original designation and monotypy.)
Παρά, beside+*Ptilotis* (*πτίλον*, feather; *οὖς*, *ὠτός*, ear). (Mathews, MS.)

Parascolopax MATHEWS, Birds of Australia, vol. 3, pt. 3, Aug. 18, 1913, p. 290.
Type, *Scolopax saturata* HODGSON.....[*Scolopacidae.*]
(Original designation and monotypy.)
Παρά, beside+*Scolopax* (*σκολόπαξ*, a large snipe-like bird). (Mathews, MS.)

Paraspizias MATHEWS, Birds of Australia, vol. 5, pt. 1, Nov. 5, 1915, p. 74.
Type, *Sparvius cirrhocephalus* VIEILLOT.....[*Buteonidae.*]
(Monotypy.)
(Subgenus of *Accipiter* or *Urospiza.*)
Παρά, beside; *σπιζίας*, the sparrow hawk. (Mathews, MS.)

Parasula MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 55.
Type, *Sula dactylatra bedouti* MATHEWS.....[*Sulidae.*]
(Original designation and monotypy.)
Παρά, beside+*Sula.* (Mathews, MS.)

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[1] A *nomen nudum* with Forbes, 1892, but Rothschild gives a description.

[2] Related to the Accipitres.

[3] Gray (Hand-List, vol. 1, 1869, p. 67) treats this as a new name for *Pallene* Lesson, 1837 (preoccupied), with *gigantea* as the only species.

[4] Two species are described, *P. lorteti* and *P. brancoi*, respectively.

Pardalotinus MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 115.
Type, *Pipra striata* GMELIN.....[*Dicaeidae.*]
(Original designation and monotypy.)
Pardalotus (παρδαλωτός, spotted like the leopard)+*inus*. (Mathews, MS.)

Parepthianura MATHEWS, Emu, vol. 12, pt. 3, Jan. 1, 1913, p. 205.
Type, *Ephthianura tricolor* GOULD.....[*Turdidae.*]
(Monotypy.)
Παρά, beside+*Epthianura* (ἐφθός, dressed; οὐρά, tail). (Mathews, MS.)

Paroxyechus MATHEWS, Birds of Australia, vol. 3, pt. 2, May 2, 1913, p. 114.
Type, *Charadrius placidus* J. E. GRAY.....[*Charadriidae.*]
(Original designation.)
(Subgenus of *Oxyechus*.)
Παρά, beside+*Oxyechus* (ὀξύηχος, shrilly sounding). (Mathews, MS.)

Parulus[1] SPIX, Avium Species Novae, vol. 1, 1824, p. 85.
Type, *Parulus ruficeps* SPIX.....[*Furnariidae.*]
(Monotypy.)

Pecoris LESSON, Compl. Buffon, vol. 8, 1837, p. 287 (note).
Type, not mentioned here; a *nomen nudum*?[2].....[*Incertae sedis.*]
(Subgenus of *Fringilla*.)

Peloperdix "Blyth" JERDON, Birds of India, vol. 3, 1864, p. 579.
Type, *Perdix charltoni* [EYTON].....[*Phasianidae.*]
(Monotypy.)

Penelops "Plin." REICHENBACH, Nat. System der Vögel, [1853], p. XXVI.
Type, *Penelope albiventris* "GOULD" [=Lesson=*P. leucogaster* GOULD].
[*Cracidae.*]
(Monotypy.)
(Subgenus of *Penelope* Merrem.)

Penelopsis BONAPARTE, Comptes Rendus, vol. 42, May, 1856, p. 877.
Emendation of *Penelops* REICHENBACH, 1853.....[*Cracidae.*]

Pengia (Hodgson, MS.) SHARPE, Cat. Birds Brit. Mus., vol. 7, 1883, p. 479.
Cited under *Crateropus "canorus"*[3] (LINNAEUS).....[*Turdoididae*]
(Monotypy.)

Pernettyva MATHEWS, Birds of Australia, vol. 3, pt. 2, May 2, 1913, p. 114.
Type, *Charadrius falklandicus* LATHAM.....[*Charadriidae.*]
(Original designation.)
(Subgenus of *Leucopolius*.)
For Antoine Joseph Pernety, 1716–1801. (Mathews, MS.)

Peronista MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 107.
Type, *Dromaius peroni* ROTHSCHILD.....[*Dromiceiidae.*]
(Original designation and monotypy.)
For François Péron, 1775–1810. (Mathews, MS.)

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[1] *Parulus* Rafinesque, 1815, is a substitute name for *Parus* Linnaeus.

[2] Under the group "Les Ammodrames," he refers in a footnote to "*Ammodramus*, Sw., Zool. Journ., n. X. Nous pensons que notre sous-genre *pecoris* (Traité d'ornith.) doit être joint à celui-ci."

[3] *Turdus canorus* Linnaeus is performing double duty in modern works, serving as the basis of both *Trochalopteron canorum* and *Crateropus "canorus."* The name of the latter should be *Turdoides terricolor* (Blyth). See note under *Turdoides*.

Petrella [1] BARTRAM, Travels through Carolina, etc., 1791, p. —— (London ed., 1792, p. 293); ZIMMERMANN, in Bartram, Reisen Nord-und Süd-Karolina, 1793, p. 293; MATHEWS, Auk, 1914, pp. 90, 91.
Type, *Petrella pintada* ZIMMERMANN = *Procellaria capensis* LINNAEUS. [*Procellariidae.*]
(Monotypy.)

Phaceloscenus RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 71.
Type, *Anumbius striaticollis* D'ORBIGNY and LAFRESNAYE.....[*Furnariidae.*]
(Original designation and monotypy.)
Φάκελος, a bundle; *σκῆνος*, a hut, tent. (Ridgway.)

Phænostictus RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 70.
Type, *Phlegopsis macleannani* LAWRENCE.....[*Formicariidae.*]
(Original designation and monotypy.)
Φαίνω, I display, exhibit; *στικτός*, marked, spotted. (Ridgway.)

Phæonetta STONE, Auk, vol. 24, No. 2, April, 1907, p. 198.
Type, *Anas fusca* LINNAEUS.....[*Anatidae.*]
(Original designation and monotypy.)
(Subgenus of *Oidemia.*)
Φαιός, brown; *νῆττα*, a duck. (Stone.)

Phalaropsis WAGLER, Isis, vol. 24, Heft 5, 1831, p. 531.
Type, *Colymbus podiceps* LINNAEUS [2].....[*Colymbidae.*]
(Monotypy.)

Phalcobœnus D'ORBIGNY, Voy. Amér. Mérid., vol 9 (Atlas), "1847" (livr. 1 or 2, 1834), Ois., pl. 2.
Type, *Phalcobœnus montanus* D'ORBIGNY.....[*Buteonidae.*]
(Monotypy.)

Philacantha "Glog. 1834" [3] GRAY, Hand-List, vol. 1, 1869, p. 214.
Type, *Motacilla nisoria* BECHSTEIN [4].....[*Sylviidae.*]
(Monotypy.)
(Subgenus of *Sylvia.*)

Philomeloïdes [5] BLYTH, in N. Wood, Brit. Song Birds, [May,] 1836, p. 25.
Type, "American spotted-breasted Thrushes".....[*Turdidae.*]

Philomelopsis C. L. BREHM, Journal für Orn., vol. 5, 1857, p. 351.
New name for *Luscinopsis* BONAPARTE.....[*Sylviidae.*]
(See *Luscinioides.*)

Phloeonerpes SUNDEVALL, Conspectum Avium Picinarum, 1866, p. 115.
Emendation of *Phaionerpes* REICHENBACH, 1854.....[*Picidae.*]

Phlogenys [6] PYCRAFT, Ibis, ser. 10, vol. 3, No. 4, October, 1915, p. 768.
Type, not mentioned, a *nomen nudum* here.....["*Ampelidae.*"]

Phoenicoperdix [7] "Blyth" HARTLAUB, Archiv für Naturgesch., vol. 26, Bd. 2, 1860, p. 99.
Type, *Tropicoperdix chloropus* BLYTH.....[*Phasianidae.*]
(Monotypy.)

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[1] This is a *nomen nudum* at 1791 and 1792, but Zimmermann adds a reference to Seligmann, and gives the Linnaean equivalent, thus fixing the name, which has priority over *Daption* Stephens, as mentioned by Mathews (Auk, vol. 31, 1914, p. 91).

[2] "Dieser Vogel ist die Grundgattung meiner Sippe "*Phalaropsis.*" "

[3] In Gloger's Volist. Handb. Vögel Europa's, 1834, pp. I and 235, it occurs as a plural group name, "*Sylviae philacanthae.*"

[4] This species is first described in Bechstein's Kurzgefasste Gemeinnütz. Naturgesch. des In-und Auslandes für Schulen, vol. 1, Abth. 1, 1792, p. 537.

[5] A *nomen nudum* here, but doubtless intended for the group now known as *Hylocichla.*

[6] Said to be "peculiar to the Greater Antilles."

[7] Appears to be a lapsus for *Tropicoperdix* Blyth.

Pholidornis HARTLAUB, Archiv für Naturgesch., vol. 22, Bd. 2, 1856, p. 23.
Type, *Dicæum rushiæ* CASSIN.....[*Sylviidae.*]
(Original designation and monotypy.)

Picathartes LESSON, Manuel d'Orn., vol. 1, [June,] 1828, p. 374.
Type, *Corvus gymnocephalus* TEMMINCK.....[*Corvidae.*]
(Original designation and monotypy.)

Piceacantor MAYNARD, Directory Birds Eastern N. A., pt. 9, 1907, p. 241.
Type, *Motacilla blackburniæ* GMELIN.....[*Mniotiltidae.*]
(Original designation and monotypy.)

Picumnoides "Malh." BONAPARTE, Ateneo Italiano, vol. 2, No. 8, May, 1854, p. 126 (or Bonaparte, Consp. Volucr. Zygodact., p. 11).
Cited as a synonym of *Sasia* HODGSON.....[*Picidae.*]

Pinacantor MAYNARD, Directory Birds Eastern N. A., pt. 9, 1907, p. 244.
Type, *Sylvia vigorsii* AUDUBON.....[*Mniotiltidae.*]
(Original designation and monotypy.)

Pithys VIEILLOT, Nouv. Dict. d'Hist. Nat., ed. 2, vol. 24, 1818, p. 112.
Type, generic diagnosis only; [1] species not mentioned.....[*Formicariidae.*]

Pityornis BONAPARTE, Revue et Mag. de Zoologie, sér 2, vol. 9, 1857, p. 163.
Type, *Emberiza "pityornis"* [=*Pithyornis*] PALLAS.....[*Fringillidae.*]
(Tautonymy.)

Platyspiza RIDGWAY, Proc. U. S. Nat. Mus., vol. 19, No. 1116, Mar. 15, 1897, p. 545
Type, *Camarhynchus variegatus* SCLATER and SALVIN .....[*Fringillidae.*]
(Original designation.)
(Subgenus of *Camarhynchus.*)

Plautus GUNNERUS, Trondhiemske Selsk. Skrifter, vol. 1, 1761, p. 263, pl. 6.
Type, "Plotus eller Plautus Columbarius" [2] [=*Alca alle* LINNAEUS]..[*Alcidae.*]
(Monotypy.)

Plautus "Klein" REICHENBACH, Nat. System der Vögel, 1852 [3] [1853], p. V.
Type, *Larus glaucus* "L. Gm." [4] [=*Larus hyperboreus* GUNNERUS]..[*Laridae.*]
(Monotypy.)
(Subgenus of *Larus.*)

†**Pleistogyps** L. H. MILLER, Univ. Calif. Publ. Dept. Geology, vol. 6, No. 1, Nov. 28, 1910, p. 16.
Type, *Pleistogyps rex* MILLER.....[*Incertae sedis.*]
(Monotypy.)
Pleistocene (πλεῖστος, most; καινός, recent)+*Gyps* (γύψ, a vulture). (Miller, MS.)

†**Plesiocathartes** GAILLARD, Annales Univ. Lyon, nouv. sér., Sciences, Médecine, fasc. 23, 1908, p. 41.
Type, *Plesiocathartes europæus* GAILLARD.....[*Cathartidae.*]
(Monotypy.)

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[1] The diagnosis is reproduced herewith: "PITHYS, *Pithys: Pipre*, Lath. Bec plus large que haut à sa base, à bords déprimés, anguleux en dessus, échancré et couré à sa pointe; tarses élevés; doigts extérieurs soudés jusqu'à la deuxième phalange; ailes arrondies et courtes."

[2] "*Plautus columbanus s. Columba Grönland. minor*" on the plate. The name "*columbanus*" is corrected to "*columbarius*" in the errata of volume 2.

[3] This portion of Reichenbach's complicated work is generally quoted as of 1852, probably because it contains a "Vorwort" dated "1. October, 1852," but it seems not to have been published until 1853. It appeared in the third Lieferung of the "Handbuch der speciellen Ornithologie," and consists of pages I-XXXI, with signature marks bearing the words "Systema Avium." Hartlaub, in his record of ornithology for 1853 (Archiv für Naturgesch., 1854, vol. 2, p. 33), includes it among the publications of that year.

[4] This = *Larus glaucus* Brünnich, 1764 (not of Pontoppidan, 1763). See Auk, vol. 25, 1908, p. 357.

†**Plioaetus** De Vis MS., Richmond, Proc. U. S. National Museum, vol. 35, No. 1656, Dec. 16, 1908, p. 592 (note).
Substitute name for *Asturaetus* De Vis, preoccupied.....[*Incertae sedis.*]

Podoces Fischer, Lettre adressée Pander,[1] 1821, p. 6.
Type, *Podoces panderi* Fischer.....[*Corvidae.*]
(Monotypy.)
Ποδώκης, pedibus celer. (Fischer.)

Pogonospiza Berlepsch and Stolzmann, Ornis, vol. 13, No. 2, September, 1906, p. 67.
Type, *Pogonospiza mystacalis brunneiceps* Berlepsch and Stolzmann.[2] [*Fringillidae.*]
(Monotypy.)

Polachio [Merrem?], in Ersch u. Gruber, Allg. Encycl., sect. 1, vol. 6, 1821, p. 267.
Type, *Gracula fœtida* Linnaeus.....[*Cotingidae.*]
(Present designation.)[3]

Poliospina Heuglin, Nachtr. u. Bericht. zur Orn. Nordost-Afrika's, 1871, p. ccxlvii.
Substitute or lapsus for *Spodiospina* Heuglin.....[*Fringillidae.*]

Polocandora Reichenbach, Nat. System der Vögel, 1852 [1853], p. V.
Type, not given; apparently a synonym of *Rissa*[4].....[*Laridae.*]

Pontochelidon Hogg, Edinburgh New Philos. Journal, vol. 41, No. 81, July, 1846, pp. 55, 69; Mathews, Austral Avian Record, vol. 2, 1915, p. 133.
Type, *Sterna caspia* Pallas.....[*Laridae.*]
(Subsequent designation; Mathews, 1915.)

Pontotriorchis Cabanis, Journal für Orn., vol. 10, 1862, pp. 250, 436.
Type, *Falco concolor* Temminck.....[*Falconidae.*]
(Present designation.[5])

Porzanoidea Mathews, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 117.
Type, *Gallinula immaculata* Swainson.....[*Rallidae.*]
(Original designation and monotypy.)
From *porzana*, Italian name of a crake. (Mathews, MS.)

Prædo Nelson, Smiths. Misc. Coll., vol. 60, No. 3, Sept. 27, 1912, p. 14.
Type, *Prædo audax* Nelson.....[*Tyrannidae.*]
(Original designation and monotypy.)
"*Prædo*=a robber." (Nelson.)

Premnornis Ridgway, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 71.
Type, *Margarornis guttata* Lawrence.....[*Furnariidae.*]
(Original designation and monotypy.)
Πρέμνον, a stump, tree trunk; ὄρνις, bird. (Ridgway.)

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[1] The full title of this tract is: Lettre adressée au nom de la Société Impériale des Naturalistes de Moscou, a l'un de ses membres M. le Docteur Chrétien-Henri Pander, par Gotthelf Fischer de Waldheim, directeur de la société; Contenant une Notice sur un nouveau genre d'Oiseau et sur plusieurs nouveaux Insectes. Moscou, MDCCCXXI. 8° Pp. 1–15. (Introduction dated "Moscou, le 17 Décembre 1821.")

[2] In Bericht über den V. Intern. Orn.-Kongress, "1910," p. 1108, Berlepsch says the type is *Pipilo mystacalis* Taczanowski.

[3] The species mentioned are "Polachio cajennensis, leterops, Cotinga foetida," without citation of authority or other means of identification. Assuming "*Cotinga*" *foetida* to be equivalent to *Gracula fœtida* Linnaeus, I have designated it as the type, thereby reducing *Polachio* to a synonym of *Gymnoderus* Geoffroy, 1809.

[4] Bonaparte (Conspectus Gen. Avium, vol. 2, 1857, p. 225) cites "*Pulocondora*, Reich." as a synonym of *Rissa*. See also Bonaparte, Naumannia, 1854, p. 217.

[5] *Falco eleonoræ* Gené is also included in this genus.

Primolius BONAPARTE, Remarques Observ. Blanchard Psittacides,[1] April, 1857, p. 6.
Type, *Arara auricollis* CASSIN [2].....[*Psittacidae.*]
(Subsequent designation; Ridgway, 1916.)

Pristoptera BONAPARTE, Rivista Contemporanea [Torino], vol. 9, fasc. 40, February, 1857, p. 210 (p. 4 of reprint); SALVADORI, Atti R. Accad. Sci. Torino, vol. 49, 1914, pp. 447–451.
Type, *Pristoptera typica* BONAPARTE=*Hirundo pristoptera* RÜPPELL. [*Hirundinidae.*]
(Monotypy and tautonymy.)

†**Progura** DE VIS, Proc. Royal Soc. Queensland, vol. 5, 1889, p. 131, plate.
Type, *Progura gallinacea* DE VIS.....[*Gouridae?*]
(Monotypy.)

Prohæmatopus MATHEWS, Birds of Australia, vol. 3, pt. 1, Apr. 2, 1913, p. 12.
Type, *Hæmatopus quoyi* BRABOURNE and CHUBB.....[*Haematopodidae.*]
(Monotypy.)
(Subgenus of *Hæmatopus.*)
Πρό, before+*Hæmatopus* (αἷμα (αιματ-), blood; πούς, foot). (Mathews, MS.)

†**Proictinia** SHUFELDT, Bull. Amer. Mus. Nat. Hist., vol. 32, Aug. 4, 1913, p. 301.
Type, *Proictinia gilmorei* SHUFELDT.....[*Incertae sedis.*]
(Monotypy.)
Πρό, before, and ἰκτῖνος, a kite. (Shufeldt.)

Promergus MATHEWS and IREDALE, Ibis, ser. 10, vol. 1, No. 3, July, 1913, p. 410.
Type, *Mergus australis* HOMBRON and JACQUINOT.....[*Anatidae.*]
(Original designation and monotypy.)
Πρό, before+*Mergus* (*mergus*, a diving bird). (Mathews, MS.)

Protopyrrhula BIANCHI, Bull. Acad. Imp. Sci. St.-Pétersb., sér. 5, vol. 25, No. 3 March, 1907, pp. 162, 193.
Type, *Pyrrhula nipalensis* HODGSON.....[*Fringillidae.*]
(Original? designation.)
(Subgenus of *Pyrrhula.*)

Psalidura [3] VAN DER HOEVEN, Handb. Dierkunde, ed. 2, vol. 2, 1855, p. 733.
Substitute name for *Phibalura* VIEILLOT.....[*Cotingidae.*]
(See also *Schizura.*)

†**Psammornis** ANDREWS, Bericht über den V. Intern. Orn.-Kongress, 1910 [1911], p. 173.
Type, *Psammornis rothschildi* ANDREWS [4].....[*Struthiones.*[5]]
(Monotypy.)

Psephotellus MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 57.
Type, *Platycercus pulcherrimus* GOULD.....[*Psittacidae.*]
(Original designation and monotypy.)

Pseudacanthis OGILVIE-GRANT, Bull. Brit. Orn. Club, vol. 31, No. 188, May 28, 1913, p. 88.
Type, *Pseudacanthis yemenensis* OGILVIE-GRANT.....[*Fringillidae.*]
(Monotypy.)

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[1] A *nomen nudum* in the original paper, published in Comptes Rendus. (See note under *Bolborhynchus.*)
[2] "PRIMOLIUS, *Bp.*, comprend les autres *Arâcs* à joues poilues, *auricollis*, Cass., *maracana*, Vieill., et makawanna, *Gm.*"
[3] Preoccupied by *Psalidura* Gloger, 1841, Tyrannidae.
[4] From the Eocene of Algeria, and based on fragments of eggshell only.
[5] Andrews says it belongs to the Eremopezinae section of the Ratitae.

Pseudaëdon BUTURLIN, Messager Ornith., vol. 1, No. 2, May, 1910, pp. 136, 139.
Type, *Larvivora sibilans* SWINHOE.....[*Turdidae.*]
(Monotypy.)
(Subgenus of *Philomela* LINK.)

Pseudalaudula BIANCHI, Bull. Acad. Imp. Sci. St.-Pétersb., sér. 5, vol. 23, No. 3, June, 1906, p. 222.
Type, *Alauda pispoletta* PALLAS [=*Alauda spinoletta* LINNAEUS] ..[*Alaudidae.*]
(Original? designation.)

Pseudartamus MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 114.
Type, "*Loxia cyanoptera* LATHAM (=*Turdus sordidus* LATHAM [1])"..[*Artamidae.*]
(Original designation and monotypy.)
(See also *Angroyan* ILLIGER, 1811.)
Ψευδής, false+*Artamus* (ἄρταμος, a butcher). (Mathews, MS.)

Pseudastrapia ROTHSCHILD, Bull. Brit. Orn. Club, vol. 21, No. 137, Nov. 29, 1907, p. 25.
Type, *Pseudastrapia lobata* ROTHSCHILD.....[*Paradisaeidae*]
(Original designation and monotypy.)

Pseudocalyptomena ROTHSCHILD, Ibis, ser. 9, vol. 3, No. 12, October, 1909, p. 690, pl. 10.
Type, *Pseudocalyptomena graueri* ROTHSCHILD.....[*Muscicapidae?*]
(Monotypy.)

Pseudocolopteryx [2] LILLO, Revista de letras y ciencias sociales [Tucumán], vol. 3, No. 13, July, 1905, pp. 38, 45.
Type, *Pseudocolopteryx dinellianus* LILLO.....[*Tyrannidae.*]
(Monotypy.)

†**Pseudogavia** SHARPE, Zool. Record, vol. 28, 1892, Aves, p. 39.
Substitute name for *Pseudolarus* AMEGHINO.....[*Stereornithes.*]

Pseudopitta REICHENOW, Journal für Orn., vol. 63, Heft 1, January, 1915, p. 129.
Type, *Eupetes incertus* SALVADORI.....[*Timaliidae.*]
(Original designation and monotypy.)

Pseudopsittacus [3] MACGILLIVRAY, Emu, vol. 13, pt. 2, Oct. 1, 1913, p. 105.
Type, *Pseudopsittacus maclennani* MACGILLIVRAY.....[*Cyclopsittacidae.*]
(Monotypy.)

Psilopornis RIDGWAY, Bull. U. S. Nat. Mus., No. 50, pt. VI, Apr. 8, 1914, p. 361.
Type, *Galbula albirostris* LATHAM.....[*Galbulidae.*]
(Original designation and monotypy.)

Psilopsiagon RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 100.
Type, *Trichoglossus aurifrons* WAGLER.....[*Psittacidae.*]
(Original designation and monotypy.)
Ψιλός, naked; σιαγών, jawbone. (Ridgway.)

Psittacina "Temm." LICHTENSTEIN, Nomencl. Avium Mus. Berol., 1854, p. 48.
Equivalent to *Psittirostra* TEMMINCK, 1820.....[*Drepanididae.*]
(See also *Psittacopis* WAGLER.)

Psittacopis "Nitzsch" WAGLER, Natürl. System der Amphibien, [August,] 1830, p. 113.
Type, *Loxia psittacea* LATHAM.....[*Drepanididae.*]
(Monotypy.)
(See also *Psittacina* LICHTENSTEIN.)

[1] Not *Turdus sordidus* of Müller, 1776.
[2] Equivalent to *Hapalocercus* Cabanis, 1847 (see Hellmayr, Novit. Zool., vol. 13, 1906, p. 321).
[3] This is equivalent to *Geoffroyus* Bonaparte (see Mathews, List of Birds Australia, 1913, p. xxv).

Pterocolpa "*Pr. B. 1854*"[1] GRAY, Cat. Genera and Subgen. Birds, 1855, pp. 97,150.[2]
Type, *Pterocolpa* [=*Ptilocolpa*] *carola* BONAPARTE..... [*Treronidae.*]
(Original designation and monotypy.)

Ptilonycterus[3] RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 98.
Type, *Caprimulgus ocellatus* TSCHUDI.....[*Caprimulgidae.*]
(Original designation and monotypy.)
(See *Nyctiphrynus.*)
Πτίλον, a feather; *νυκτερίς*, a bat. (Ridgway.)

Ptilosclera[4] BONAPARTE, Remarques Observ. Blanchard Psittacides, April, 1857, p. 6.
Type, *Trichoglossus versicolor* VIGORS.....[*Loriidae.*]
(Original designation and monotypy.)

Ptilotina MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 60.
Type, *Ptilotis analoga mixta* MATHEWS.....[*Meliphagidae.*]
(Original designation and monotypy.)
Ptilotis (*πτίλον*, feather; *οὖς, ὠτός*, ear)+*ina.* (Mathews, MS.)

Ptilotula MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 414.
Type, *Ptilotis flavescens* GOULD.....[*Meliphagidae.*]
(Original designation and monotypy.)
Ptilotis (*πτίλον*, feather; *οὖς, ὠτός*, ear)+*ula.* (Mathews, MS.)

Purnella MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 111.
Type, *Gliciphila albifrons* GOULD.....[*Meliphagidae.*]
(Original designation and monotypy.)
For Herbert A. Purnell. (Mathews, MS.)

Purnellornis MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 112.
Type, *Certhia nigra* BECHSTEIN.....[*Meliphagidae.*]
(Original designation.)
For Herbert A. Purnell+*ornis.* (Mathews, MS.)

Pyrgilauda "Verr." BONAPARTE, Conspectus Gen. Avium, vol. 1, 1850, p. 511.
Cited as a synonym of *Pyrrhulauda* "Smith. 1829"[5].....[*Alaudidae.*]

Quoyornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 111.
Type, *Muscicapa georgiana* QUOY and GAIMARD.....[*Muscicapidae.*]
(Original designation and monotypy.)
For Jean René Constant Quoy, 1790–1869+*ornis.* (Mathews, MS.)

†**Ralloides** SHUFELDT, Journal Acad. Nat. Sci. Phila., vol. 9, pt. 3, Oct. 20, 1892, p. 412 (note).
Substitute name for *Creccoides* SHUFELDT.....[*Rallidae.*]

Ramphaoratus BONAPARTE, Rivista Contemporanea [Torino], vol. 9, fasc. 40, February, 1857, p. 215 (p. 9 of reprint); SALVADORI, Atti R. Accad. Sci. Torino, p. 49, 1914, pp. 447–451.
Type, *Caprimulgus exilis* LESSON.....[*Caprimulgidae.*]
(Virtual monotypy.[6])

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[1] Gray, List Spec. Birds, vol. 4, Columbae, 1856, p. 16, gives the authority as "*Pr. B. in litt.*"

[2] In the Appendix, p. 150, he says: "Pterocolpa, since altered to Ptilocolpa, *Pr. B.*"

[3] Mr. Ridgway says "this genus may possibly have already been named, the generic term *Nyctiphrynus* Bonaparte having been used in connection with the type species." Salvadori (Atti R. Accad. Sci. Torino, vol. 49, 1914, p. 451) has since demonstrated this to be the case.

[4] This is a *nomen nudum* in the original Comptes Rendus paper. (See note under *Bolborhynchus.*) Is equivalent to *Psitteuteles* Bonaparte, 1854.

[5] Smith claims to have instituted this name "in the year 1829," but I have not met with it earlier than 1837, although Swainson mentions a name "*Pyralauda*" in 1834 (Murray's Encycl. Geogr.), where, however, it is a *nomen nudum.*

[6] See Oberholser, Bull. U. S. Nat. Mus., No. 86, Apr. 6, 1914, p. 3.

Ramsayornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 115.
Type, *Gliciphila subfasciata* RAMSAY.....[*Meliphagidae.*]
(Original designation and monotypy.)
For Edward Pierson Ramsay, 1842?—1916+*ornis*. (Mathews, MS.)

Raperia MATHEWS, Austral Avian Record, vol. 3, No. 1, June 30, 1915, pp. 21, 23.
Type, *Raperia godmanæ* MATHEWS.....[*Treronidae.*]
(Original designation and monotypy.)
For George Raper. (Mathews.)

Raphipterus GAY, Hist. Chile, Atlas, [1844,] pl. "Zoologia No." [1]
Type, *Raphipterus chilensis* GAY.....[*Anatidae.*]
(Monotypy.)

Razocorys BIANCHI, Bull. Acad. Imp. Sci. St. Pétersb., sér. 5, vol. 23, No. 3, 1906, p. 230.
Type, *Spizocorys razæ* ALEXANDER.....[*Alaudidae.*]
(Original? designation and monotypy.)

Reginopus MATHEWS, Austral Avian Record, vol. 2, No. 4, Dec. 29, 1913, p. 73.
Type, *Ptilinopus ewingii* GOULD.....[*Treronidae.*]
(Original designation and monotypy.)
Regina, a queen; *opus*, a work (the work of a queen). (Mathews, MS.)

Regulus BARTRAM, Travels through Carolina, etc., 1791, p. — (London ed., 1792, pp. 289, 290; ZIMMERMANN, in Bartram, Reisen Nord-und Süd-Karolina, 1793, p. 287; MATHEWS, Auk, 1914, pp. 89, 90.)
Type, *Motacilla calendula* LINNAEUS [2].....[*Regulidae.*]
(Present designation.) [3]

Reinarda HARTERT, Bull. Brit. Orn. Club, vol. 36, No. 210, Dec. 3, 1915, p. 7.
New name for *Claudia* HARTERT, preoccupied.....[*Micropodidae.*]
Type, *Cypselus squamatus* CASSIN.
(Orginal designation and monotypy.)

Reinholdia MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 107.
Type, *Puffinus reinholdi* MATHEWS.....[*Puffinidae.*]
(Original designation and monotypy.)
For Johann Reinhold Forster, 1729–1798. (Mathews, MS.)

Rhodoglaux "Pr. B. 1854" GRAY, Cat. Gen. and Subgen. Birds, 1855, p. 135.
Cited as a synonym of "*Rabdoglaux*" [=*Rhabdoglaux*] BONAPARTE, with "*Strix humeralis*, Pr. B." as the type [4].....[*Strigidae.*]

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[1] The number of the plate is not indicated in the copy seen by me. As to the date, Des Murs (Icon. Orn., livr. 1, text to pl. 5, dated "mai 1845") cites it as 1844, and Agassiz (1846) and Gray (1849) also give this date. I am unable at present to give the number of the livraison in which the plate appeared.

[2] Seven species of *Regulus* are enumerated by Bartram in 1791, but only one is technically available as type at this date. This is "R. cristatus alter vertice rubini coloris: the ruby crown wren. (G. Edwards.)", or *Motacilla calendula* Linnaeus. Edwards figured and described this species from a specimen sent to him by Bartram. Another species mentioned by Bartram is "M[otacilla] Caroliniana: (reg. magnus) the great wren of Carolina, the body of a dark brown, the throat and breast of a pale clay colour," but it would be unfortunate to designate this as the type, even if considered adequately described. In 1793, Zimmermann fixed the status of two or three other species, but with these we are not concerned at present.

[3] There appear to be excellent generic differences between *Motacilla calendula* and *M. regulus*, as long ago recognized by Cabanis, who, in 1853, proposed the name *Corthylio* for *M. calendula*. This genus has been recently revived by Mr. Miller (Auk, vol. 32, 1915, pp. 234–236), but from the above reference to *Regulus* it will be seen that *Motacilla regulus* is the species to be provided with a generic name. Macgillivray (Hist. Brit. Birds, vol. 2, 1838, p. 407) writes: "But should any one desire another generic name, let him choose from among the following, which have all been applied to the "Gold-crested Wren:"—Calendula, Parus, Regulus, Regillus, Rex, Senator, Basiliscus, Regaliolus, Orchillus, Tyrannus, Motacilla, Sylvia, Passerculus." There is also *Orchilus* Morris, 1837.

[4] *Rhodoglaux* is adopted by Fitzinger (Sitzungsber. K. Akad. [Wien], vol. 21, Heft 2, 1856, p. 291) as a subgenus of *Athene* "Gray," with "*Strix*" [=*Athene*] *humeralis* Bonaparte as the only species.

Rhopoctites RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 72.
Type, *Philydor rufo-brunneus* LAWRENCE.....[*Furnariidae.*]
(Original designation and monotypy.)
'Ρώψ (ῥωπός), bush, underwood; κτίτης, a colonist, inhabitant. (Ridgway.)

Rhoporchilus RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 69.
Type, *Formicivora speciosa* SALVIN.....[*Formicariidae.*]
(Original designation and monotypy.)
'Ρώψ (ῥωπός), bush, underwood; ὄρχίλος, a wren. (Ridgway.)

Rogersornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 117.
Type, *Ptilonorhynchus nuchalis* JARDINE and SELBY.....[*Ptilonorhynchidae.*]
(Original designation and monotypy.)
For John Porter Rogers. (Mathews, MS.)

Rogibyx MATHEWS, Birds of Australia, vol. 3, pt. 1, Apr. 2, 1913, p. 41.
Type, *Vanellus cucullatus* TEMMINCK= *V. tricolor* HORSFIELD ...[*Charadriidae.*]
(Monotypy.)
For John Porter Rogers+*ibyx* (ἶβυξ, the ibis). (Mathews, MS.)

Rosina MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 113.
Type, *Malurus coronatus* GOULD.....[*Sylviidae.*]
(Original designation and monotypy.)
For Ethel Rose White (Mrs. Samuel Albert White). (Mathews, MS.)

Royigerygone MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 110.
Type, *Gerygone mathewsæ* MATHEWS.....[*Muscicapidae.*]
(Original designation and monotypy.)
For Roy Bell+*Gerygone*. (Mathews, MS.)

Rubicola[1] "Vieill." JAMESON, ed. Wilson's Amer. Orn., vol. 3 (Constable's Miscellany, vol. 70), 1831, p. 98.
Type, *Scolopax minor* GMELIN.....[*Scolopacidae.*]
(Monotypy.[2])

Rubicola[3] "Hodgson" BLYTH, Journ. Asiat. Soc. Bengal, vol. 11, No. 128, 1842, p. 808.
Type, *Coturnix pentah* SYKES [=*Perdix asiatica* LATHAM].....[*Phasianidae.*]
(Tautonymy.)
(See also *Microplectron.*)

Rupicola BOGDANOW, Trudy S.-Peterb. obshch. estest. (Zool.), vol. 12. 1881, p. 99.
Type, *Columba livia* "BRISSON"[4].....[*Columbidae.*]
(Present designation.)
(Subgenus of *Columba.*)

Rupisitta BUTURLIN, Mitteil. des Kaukasischen Museums, vol. 3, Lief. 1, April, 1907, pp. 49, 64.
Type, *Sitta dresseri* ZARUDNY[5].....[*Sittidae.*]
(Subgenus of *Sitta.*)

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[1] Doubtless intended for *Rusticola* Vieillot, but it has exactly the same status as *Pomatorhynchus* Boie (vs. *Pomatorhinus* Horsfield), and should replace *Philohela* Gray.

[2] Virtual monotypy, as the European Woodcock is mentioned incidentally, without its systematic name.

[3] Blyth says: "The three next are pigmy Partridges, and exhibit every character of the genus *Perdix*, both as to form and habits; insomuch that I cannot recognise the genus *Rubicola*, Hodgson, proposed for them in the 'Bengal Sporting Magazine' for May, 1837." The three species are *Coturnix argoondah* Sykes, *C. pentah* Sykes, and *C. erythrorhyncha* Sykes. Hodgson is said to have described *Perdicula rubicola* [= *Coturnix pentah* Sykes= *Perdix asiatica* Latham] in the Bengal Sporting Magazine, 1837, p. 344, and Blyth possibly suffered a lapse of memory in writing *Rubicola* for *Perdicula*, but I have not verified the reference.

[4] Two species are included; *C. livia* (with three subspecies) and *C. rupestris* "Pallas."

[5] This is cited as the "most typical species."

Rusticola HOUTTUYN, in Nozeman, Nederl. Vogelen, vol. 1, 1770 (p. 1 of inhoud).
Type, *Rusticola grutto* HOUTTUYN [=*Scolopax limosa* LINNAEUS]. [*Scolopacidae.*]
(Monotypy.)

Ruticilla[1] BARTRAM, Travels through Carolina, etc., 1791, p. — (London ed., 1792, p. 290); ZIMMERMANN, in Bartram, Reisen Nord-und Süd-Karolina, 1793, p. 287; MATHEWS, Auk, 1914, pp. 89, 91.
Type, "Ruticilla Americana; the redstart"; a *nomen nudum* here. [*Mniotiltidae.*]
(Monotypy.)

Ryania MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 113.
Type, *Muscicapa melanocephala* LATHAM..... [*Sylviidae.*]
(Original designation and monotypy.)
For Charles Ryan. (Mathews, MS.)

Sacramela MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 111.
Type, *Ptilotis keartlandi* NORTH..... [*Meliphagidae.*]
(Original designation.)
Sacra, sacred; *melos*, a tune, song. (Mathews, MS.)

Sagittarius[2] "Bodd." HERMANN, Tabula Affin. Animalium, 1783, pp. 136, 165, 235.
Type, "Sagittarius" of BODDAERT [=*Falco serpentarius* J. F. MILLER]. [*Sagittariidae.*]
(Monotypy.)

Salicaria SELBY, Trans. Nat. Hist. Soc. of Northumberland, Durham, and Newcastle upon Tyne, vol. 1, 1831, p. 254.
Type, *Sylvia salicaria* "LATHAM"[3]..... [*Sylviidae.*]
(Tautonymy.)

Samuela MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 112.
Type, *Cinclosoma cinnamomeum* GOULD..... [*Timaliidae.*]
(Original designation and monotypy.)
For Samuel Albert White, 1873– (Mathews, MS.)

Saxicoloides LESSON, in Bélanger, Voyage aux Indes-Orientales, Zoologie, livr. 4, 1834 [=1831],[4] p. 270.
Type, *Turdus* (*Saxicoloides erythrurus* LESSON [=*Sylvia cambaiensis* LATHAM, female]..... [*Timaliidae.*]
(Monotypy.)
(Subgenus of *Turdus*.)

Scæophaethon MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 56.
Type, *Phaethon rubricauda westralensis* MATHEWS..... [*Phaëthontidae.*]
(Original designation and monotypy.)
Σκαιός, awkward, clumsy + *Phaëthon* (Φαέθων, son of Helios). (Mathews, MS.)

[1] This is a *nomen nudum* with Bartram, and Zimmermann does not improve matters by adding "Der Amerikanische Rothschwanz. (Mot. phönicurus?)"

[2] Several names have been proposed for this group: *Sagittarius* Hermann, 1783; *Gypogeranus* Borkhausen, 1797; *Serpentarius* Cuvier, 1798; *Secretarius* Daudin, 1800; *Ophiotheres* Vieillot, 1816, and *Amphiserpentarius* Gaillard, 1908, the last for a fossil genus. Of these, *Sagittarius* has clear priority, and should be adopted in place of the two or three names in current use. Boddaert (Dierkundig Mengelwerk, vol. 5, 1770, p. 17) and Vosmaer (Beschryving Afrik. Roof-Vogel, de Sagittarius genaamd, 1769, p. 1) have been cited as authorities for this name, but neither of them used it in a generic sense.

[3] The included species are *Sylvia locustella* Latham and *S. salicaria* "Latham" (the "Sedge-Warbler").

[4] Sherborn and Woodward (Ann. Mag. Nat. Hist., ser. 7, vol. 17, March, 1906, p. 390) accept August, 1832, as the date of livraison 4 of this work, but the first five parts are said to have been "terminées et publiées" by the reviewer of them in Férussac's Bull. Sci. Nat., vol. 26, for September, 1831, p. 291, and there can be no question that *Saxicoloides* was published in this year. It is some months earlier than *Thamnobia* Swainson, which appeared in February, 1832.

Schizura [1] VAN DER HOEVEN, Handb. Dierkunde, ed. 2, vol. 2, 1855, p. 733.
Substitute name for *Phibalura* VIEILLOT.....[*Cotingidae.*]
(See also *Psalidura* VAN DER HOEVEN.)

Schoeniophylax RIDGWAY, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 71.
Type, *Sylvia phryganophila* VIEILLOT.....[*Furnariidae.*]
(Original designation and monotypy.)
Σχοινιά, a bunch of rushes; φύλαξ, a watcher, guard, sentinel. (Ridgway.)

Sciopsar REICHENOW, Journal für Orn., vol. 62, Heft 2, April, 1914, p. 289.
Type, *Agelaeus imthurni* SCLATER.....[*Icteridae.*]
(Original designation and monotypy.)
(=*Pseudagelæus* RIDGWAY, 1901.)

Semnarchus RIDGWAY, Bull. U. S. Nat. Mus., No. 50, pt. 4, July 1, 1907, p. 689.
Type, *Tyrannus crassirostris* SWAINSON.....[*Tyrannidae.*]
(Original designation and monotypy.)
(Subgenus of *Tyrannus.*)
Σεμνός, solemn; αρχός, a ruler, chief, or leader. (Ridgway.)

Senegalus [2] (Brisson) LAFRESNAYE, Rev. et Mag. Zool., sér. 2, vol. 4, 1852, p. 49, pl. 2.
Type, *Senegalus striatus* "BRISSON" =*Loxia astrild* LINNAEUS.....[*Ploceidae.*]
(Monotypy.)

Setibis "Lesson" BONAPARTE, Comptes Rendus, vol. 43, No. 21, November, 1856, p. 993.
Equivalent to *Carphibis* REICHENBACH, 1853.....[*Threskiornithidae.*]

Setochalcis OBERHOLSER, Bull. U. S. Nat. Mus., No. 86, Apr. 6, 1914, p. 11.
Type, *Caprimulgus vociferus* WILSON.....[*Caprimulgidae.*]
(Original designation.)
Σής, σητός, tinea; χαλκίς, avis nocturna. (Oberholser.)

Setopagis RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 98.
Type, *Caprimulgus parvulus* GOULD.....[*Caprimulgidae.*]
(Original designation and monotypy.)
Σής, σητός a moth; παγίς, a trap. (Ridgway.)

Setosura MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 58.
Type, *Rhipidura setosa melvillensis* MATHEWS.....[*Muscicapidae.*]
(Original designation and monotypy.)
Setos(a)+(Rhipid)*ura.* (Mathews, MS.)

Sheppardia HAAGNER, Annals Transvaal Mus., vol. 1, No. 3, January, 1909, p. 180, plate.
Type, *Sheppardia gunningi* HAAGNER.....[*Muscicapidae.*]
(Monotypy.)

Sittina "Temm." SCHINZ, Thierreich, vol. 4, 1825, p. 543.
Cited as a synonym of *Sphenura* LICHTENSTEIN.....[*Timaliidae.*]

Snethlagea BERLEPSCH, Journal für Orn., vol. 57, Heft 1, January, 1909, p. 104.
Type, *Euscarthmus zosterops minor* SNETHLAGE.....[*Tyrannidae.*]
(Original designation and monotypy.)
For Emilia Snethlage. (Berlepsch.)

Sporothlastes CABANIS, Archiv für Naturgesch., vol. 13, pt. 1, 1847, p. 331.
Substitute name for *Amadina* SWAINSON.....[*Ploceidae.*]

[1] Preoccupied by *Schizura* Cabanis, 1847 (Furnariidae).
[2] There is a possibility that *Senegalus* and several other Brissonian nongeneric names may have to be quoted from Dumont, Dict. Sci. Nat., vol. 17, 1820, p. 399.

Spreo "Less." GRAY, List Genera Birds, 1840, p. 40.
Type, "S. bicolor, (Gm.) *Less.*" [=*Turdus bicolor* GMELIN].....[*Sturnidae.*]
(Original designation and monotypy.)

Stenura "Swains." CUVIER, Règne Animal, ed. 2, vol. 1, 1829, p. 582.
Lapsus for *Culicivora* SWAINSON.
Type, *Muscicapa stenura* TEMMINCK.....[*Incertae sedis.*[1]]
(Tautonymy and monotypy.)

Sternolophota "Lesson" BONAPARTE, Comptes Rendus, vol. 43, No. 21, November, 1856, p. 993.
Equivalent to *Inca* STRICKLAND, 1850.....[*Laridae.*]

Sterparola BONAPARTE, Iconogr. Fauna Italica, vol. 1, 1841 (fasc. 30), Introd. Uccelli, p. [7].
Type, *Motacilla sylvia* LINNAEUS.....[*Sylviidae.*]
(Subsequent designation; Gray, 1848.)[2]
(Subgenus? of *Sylvia.*)
Native name "*Sterpazzola.*" (Bonaparte.)

Stilbo [MERREM?], in Ersch u. Gruber, Allg. Encycl., sect. 1, vol. 1, 1818, p. 327 (note).
Type, "Acker Drossel," or "*Stilbo* roseus".....[*Sturnidae.*]
(Monotypy.)[3]

Streptocichla CABANIS, Journal für Orn., vol. 30, Heft 3, July, 1882, p. 321.
Type, *Turdus strepitans* [A. SMITH].....[*Turdidae.*]
(Monotypy.)

Streptoprocne[4] OBERHOLSER, Proc. Biol. Soc. Washington, vol. 19, May 1, 1906, p. 69.
Type, *Hirundo zonaris* SHAW.....[*Micropodidae.*]
(Original designation.)
Στρεπτός, *torquis*, and Πρόκνη, *Progne.* (Oberholser.)

†**Strigogyps** GAILLARD, Annales Univ. Lyon, Nouv. sér., vol. 1, Sciences, Médecine, fasc. 23, 1908, p. 39.
Type, *Strigogyps dubius* GAILLARD.....[*Incertae sedis.*]
(Monotypy.)

Stringonax, W. DEW. MILLER, Bull. Amer. Mus. Nat. Hist., vol. 34, Oct. 20, 1915, p. 515.
Type, *Bubo blakistoni* SEEBOHM.....[*Strigidae.*]
(Original designation.)
Στρίγξ (στριγγός), owl; ἄναξ, king. (Miller, MS.)

Subglareola MATHEWS, Birds of Australia, vol. 3, pt. 4, Dec. 31, 1913, p. 321.
Type, *Glareola ocularis* VERREAUX.....[*Cursoriidae.*]
(Original designation and monotypy.)
Sub, under+*Glareola* (*glareola*, dim. of *glarea*, gravel). (Mathews, MS.)

Submyiagra MATHEWS, Austral Avian Record, vol. 2, No. 2–3, Oct. 23, 1913, p. 61.
Substitute name for *Platygnathus* HARTLAUB, 1852 (not of DEJEAN, 1834, etc.).
Type, *Platyrhynchos vanikorensis* QUOY and GAIMARD.....[*Muscicapidae.*]
(Original designation and monotypy.)
Sub, under+*Myiagra* (μυῖα, a fly; ἄγρα, hunting). (Mathews, MS.)

[1] Usually placed in the Tyrannidae, but is said to have only 10 rectrices, and Ridgway (Bull. U. S. Nat. Mus., No. 50, pt. 4, 1907, p. 340) says "almost certainly" not a member of this family.

[2] Gray, Gen. Birds, vol. 1, 1848, p. 174. Here used in the sense of *Sylvia communis* Latham.

[3] In a later volume (6, 1821, p. 266) "Stilbo (sanlaris cristatellus, tristis)" are mentioned, but without further explanation.

[4] For *Hemiprocne* of authors, not of Nitzsch, 1829, nor Riemann, 1838.

Subsmicrornis CAMPBELL and others, Emu, vol. 12, pt. 3, Suppl., January, 1913, p. 15.

Hypothetical subgenus for *Smicrornis brevirostris flavescens* GOULD.

[*Muscicapidae.*]

Subspilura MATHEWS, Birds of Australia, vol. 3, pt. 3, Aug. 18, 1913, pp. 295, 300.

Type, *Gallinago megala* SWINHOE.....[*Scolopacidae.*]

(Original designation and monotypy.)

Sub, under+*Spilura* (*σπίλος*, a spot; *οὐρά*, tail). (Mathews, MS.)

Sulita MATHEWS, Austral Avian Record, vol. 2, No. 7, Jan. 28, 1915, p. 123.

New name for *Morus* VIEILLOT, 1816 (preoccupied by *Morum* BOLTEN, 1798).

Type, *Sula bassana* LINNAEUS.....[*Sulidae.*]

(Original designation and monotypy.)

Sula+*ita*. (Mathews, MS.)

Sylvicola BOGDANOW, Trudy S.-Peterb. obshch. estest. (Zool.), vol. 12, 1881, p. 99.

Type, *Columba fusca* "PALLAS" [1].....[*Columbidae.*]

(Present designation.)

(Subgenus of *Columba*.)

Sylviocantor MAYNARD, Directory Birds Eastern N. A., pt. 9, 1907, p. 239.

Type, *Motacilla pensylvanica* LINNAEUS.....[*Mniotiltidae.*]

(Original designation and monotypy.)

Systellura RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 97.

Type, *Stenopsis ruficervix* SCLATER.....[*Caprimulgidae.*]

(Original designation and monotypy.)

Συστέλλω, to bridge; *οὐρά*, tail. (Ridgway.)

Tapera THUNBERG,[2] Götheborgs kongl. Wettenskaps och Witterhets Samhällets Nya Handlingar, vol. 3, 1819, p. 1, pl. 1.

Type, *Tapera brasiliensis* THUNBERG [=*Cuculus nævius* LINNAEUS].

[*Cuculidae.*]

(Monotypy.)

Tapera BONAPARTE, Rivista Contemporanea [Torino], vol. 9, fasc. 40, February, 1857, p. 211 (p. 5 of reprint); SALVADORI, Atti R. Accad. Sci. [Torino], vol. 49, 1914, pp. 447–451.

Type, *Hirundo pascuum* WIED=*Hirundo tapera* LINNAEUS.....[*Hirundinidae.*]

(Tautonymy.)

Taphrospilus SIMON, Revue Franç. Orn., vol. 1, No. 17–18, October, 1910, p. 261.

Type, *Aphantochroa hypositicta* GOULD.....[*Trochilidae.*]

(Original designation and monotypy.)

Tasmanornis MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 353.

Type, *Sericornis humilis* GOULD.....[*Sylviidae.*]

(Original designation and monotypy.)

Tasmania+ornis (*ὄρνις*, a bird). (Mathews, MS.)

[*Tephronotus* "Hodgson" of Waterhouse (Index, p. 220), is a specific name with Hodgson.]

†**Teratornis** L. H. MILLER, Univ. Calif. Publ. Dept. Geology, vol. 5, No. 21, Sept. 10, 1909, p. 307.

Type, *Teratornis merriami* MILLER.....[*Incertae sedis.*]

(Monotypy.)

Τέρας (*τερατ*—), a monster; *ὄρνις*, bird. (A double meaning of large and of abnormal. Miller, MS.)

[1] Two species are mentioned, *Columba fusca* "Pallas," and *C. œnas* "Brisson."

[2] This name appeared in the last supplement, but is here reproduced, with fuller citation, the reference having been verified for me by Dr. L. Stejneger a few years ago.

Terracantor MAYNARD, Directory Birds Eastern N. A., pt. 9, 1907, p. 245.
Type, *Motacilla palmarum* GMELIN.....[*Mniotiltidae.*]
(Original designation and monotypy.)

Terraphaps MATHEWS, Austral Avian Record, vol. 1, No. 8, Mar. 20, 1913, p. 195.
Type, *Geophaps smithi* JARDINE and SELBY.....[*Claraviidae.*]
(Original designation and monotypy.)
Terra, the earth+*Phaps* (*φάψ*, a pigeon). (Mathews, MS.)

Tetraoperdix[1] HODGSON, Madras Journal of Lit. and Sci., vol. 5, No. 15, for April, 1837, p. 302.
Substitute name for *Lerwa* HODGSON.....[*Phasianidae.*]

[*Thamnocenchris* "Salvin" of Waterhouse (Index, p. 222), is a snake!]

Thectocercus RIDGWAY, Proc. Biol. Soc. Washington, vol. 25, May 4, 1912, p. 99.
Type, *Psittacus acuticaudatus* VIEILLOT.....[*Psittacidae.*]
(Original designation and monotypy.)
Θηκτός, sharp; *κέρκος*, tail. (Ridgway.)

Thelazomenus REICHENOW, Journal für Orn., vol. 63, Heft 1, January, 1915, p. 127.
Type, *Thelazomenus poecilocercus* REICHENOW.....[*Meliphagidae.*]
(Monotypy.)

Thermochalcis RICHMOND, Proc. Biol. Soc. Washington, vol. 28, Nov. 29, 1915, p. 180. New name for *Stenopsis* CASSIN, 1851 (not of RAFINESQUE, 1815).
Type, *Caprimulgus cayennensis* GMELIN.....[*Caprimulgidae.*]
(Original designation and monotypy.)
Θερμός, warm; *χαλκίς*, a night bird. (Richmond.)

Tigribaphe REICHENOW, Ornith. Monatsber., vol. 20, No. 4, April, 1912, p. 61.
Type, *Tigribaphe leucolaema* REICHENOW[2].....[*Ardeidae.*]
(Monotypy.)

Tinamus HERMANN,[3] Tabula Affin. Animalium, 1783, pp. 164, 235.
Type, *Tetrao major* GMELIN.....[*Tinamidae.*]
(Present? designation.)

Tisa A. H. CLARK, Proc. U. S. Nat. Mus., vol. 32, No. 1539, June 15, 1907, p. 467.
Type, *Emberiza variabilis* TEMMINCK.....[*Fringillidae.*]
(Original designation and monotypy.)
"From the Russian птица (signifying bird)." (Clark.)

Toburides MATHEWS, Austral Avian Record, vol. 1, No. 8, Mar. 20, 1913, p. 195.
Type, *Butorides rogersi* MATHEWS.....[*Ardeidae.*]
(Original designation and monotypy.)
Anagram of *Butorides*. (Mathews, MS.)

Tomirdus MATHEWS, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 193.
Type, *Eulabeornis tricolor robinsoni* MATHEWS.....[*Rallidae.*]
(Original designation and monotypy.)
A "made up" name. (Mathews, MS.)

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[1] "The lateral small scales of the fore toes are free, giving the pectinated appearance of the feet in the grouse, to which genus our bird has numberless affinities, external and internal: so much so that Tetraoperdix might very well designate the new genus I have proposed for it, if that word were not somewhat unmanageable, in comparison of our Lerwa, which I have therefore preferred, native though it be."

[2] The type, *T. lucolaema*, is compared with "*Tigrisoma leucolophum*," which is "sehr ähnlich." The latter is the type of *Tigriornis* Sharpe (emended to *Tigrornis* in Cat. Birds Brit. Mus., vol. 26, p. 191), a genus not referred to by Reichenow, and it is not improbable that *Tigribaphe* will prove to be a synonym.

[3] This genus is based on Buffon, Hist. Nat. Ois., vol. 4, p. 502, etc. The species *Tetrao major* is not mentioned in Hermann's work.

Tonophoyx MATHEWS, Austral Avian Record, vol. 1, No. 8, Mar. 20, 1913, p. 195.
Type, *Notophoyx flavirostris* SHARPE.....[*Ardeidae.*]
(Original designation and monotypy.)
Τόνος, force, strength+*Phoyx* (φῶυξ, a heron). (Mathews, MS.)

Torrentaria (Hodgson, MS.) J. E. GRAY, Cat. Mam. Birds, etc., Nepal and Tibet, ed. 2, 1863, p. 34; SHARPE, Cat. Birds Brit. Mus., vol. 7, 1883, p. 47.[1]
A synonym of *Chaimarrornis* HODGSON, 1844.....[*Turdidae.*]

Toxorhamphus STRESEMANN, Novit. Zool., vol. 21, No. 4, Oct. 20, 1914, p. 394.
Type, *Cinnyris novæguineæ* LESSON.....[*Nectariniidae.*]
(Original designation.)
Τόξον, *arcus*; ῥάμφος, *rostrum*. (Stresemann.)

Tregellasia MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 110.
Type, *Eopsaltria capito* GOULD.....[*Muscicapidae.*]
(Original designation and monotypy.)
For Thomas H. Tregellas. (Mathews, MS.)

Trichodere NORTH, Ibis, ser. 6, vol. 6, No. 1, January, 1912, p. 120.
Type, *Ptilotis cockerelli* GOULD.....[*Meliphagidae.*]
(Original designation and monotypy.)
(See also *Hemiptilotis*.)

Tridactylocolaptes[2] COUES, Birds Northwest, 1874 [1875], p. 283.
Type, *Cuculus auratus* LINNAEUS.....[*Picidae.*]
(Monotypy.)

Tringoides BONAPARTE, Annals Lyceum Nat. Hist. New York, vol. 2, "1828" [November, 1827], p. 326.
Type, *Tringa macularia* "WILS."[3].....[*Scolopacidae.*]
(Present designation.)
(Section or subgenus of *Totanus* "BECHST.")

Turdoides[4] CRETZSCHMAR, in Rüppell, Atlas Reise nördlichen Afrika, Heft 2, 1826, Vögel, p. 6, pl. 4.
Type, *Turdoides leucocephalus* CRETZSCHMAR.....[*Turdoididae.*]
(Monotypy.)

Turtur BODDAERT, Table Pl. Enl., 1783, p. 10; MATHEWS, Novit. Zool., vol. 17, 1910, p. 503; MATHEWS and IREDALE, Austral Avian Record, vol. 3, 1915, p. 38.
Type, "*Turtur afra*, LINN." [=*Columba afra* LINNAEUS].....[*Claraviidae.*]
(Monotypy.)

Uropsalis W. DEW. MILLER, Bull. Amer. Mus. Nat. Hist., vol. 34, Oct. 20, 1915, p. 516.
Type, *Hydropsalis lyra* BONAPARTE.....[*Caprimulgidae.*]
(Original designation.)
Οὐρά, tail; ψαλίς, shears=shears tail. (Miller, MS.)

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[1] Not adopted by the authorities cited.

[2] "I once shot, at Washington, D. C., a specimen of *Colaptes auratus* showing the same thing, the right inner hind toe being wanting. It did not occur to me, however, to propose a genus *Tridactylocolaptes* . . . ."

[3] *Tringa hypoleucos* of Europe is also included by Bonaparte.

[4] *Turdoides* appears to be the earliest name for the group now known as *Crateropus*. The first appearance of *Crateropus* is in Swainson's Zoological Illustrations, ser. 2, vol. 2, No. 17, August, 1831, pl. 80, with *Crateropus reinwardii* as type, but Jardine had already used the name (as *Cratopus*) for *Cratopus bicolor* (Jardine, Edinb. Journ. Nat. and Geogr. Sci., vol. 3 (or n. s., vol. 1), No. 2, February, 1831, p. 97, pl. 3)

Vagans "Leach" [BLYTH?], in Partington's Brit. Cyclop. Nat. Hist., vol. 1, 1835, p. 611, fig.
Type, "*Parus caudatus*, and *Longicaudatus*, auctorum" [1] .....[*Paridae.*]
(Monotypy.)

Verreauxia HARTLAUB, Archiv für Naturgesch., vol. 22, Bd. 2, 1856, p. 28.
Type, *Sasia africana* VERREAUX.....[*Picidae.*]
(Original designation and monotypy.)

Vetola MATHEWS, Birds of Australia, vol. 3, pt. 2, May 2, 1913, p. 191.
Type, *Scolopax lapponica* LINNAEUS.....[*Scolopacidae.*]
(Original designation.)
Vetola, a Venetian name (see Brisson, Orn., vol. 5, pp. 76, 263). (Mathews, MS.)

Vireocantor MAYNARD, Directory Birds Eastern N. A., pt. 9, 1907, p. 242.
Type, *Motacilla virens* GMELIN.....[*Mniotiltidae.*]
(Original designation.)

Vociferator W. H. Y., Mag. of Nat. Hist. [Loudon's], vol. 7, No. 44, December, 1834, p. 636.
Substitute name for *Caprimulgus* LINNAEUS.....[*Caprimulgidae.*]
(See also *Nyctivociferator*.)

Whiteornis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 110.
Type, *Muscicapa goodenovii* VIGORS and HORSFIELD.....[*Muscicapidae.*]
(Original designation and monotypy.)
For Samuel Albert White, 1873– (Mathews, MS.)

Whitlocka MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 115.
Type, *Climacteris melanura* GOULD.....[*Certhiidae.*]
(Original designation and monotypy.)
For F. Lawson Whitlock. (Mathews, MS.)

Wilsonavis MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 110.
Type, *Psilopus fusca* GOULD.....[*Muscicapidae.*]
(Original designation and monotypy.)
For F. Erasmus Wilson. (Mathews, MS.)

Woodfordia NORTH, Victorian Naturalist, vol. 23, No. 5, Sept. 6, 1906, p. 104, pl. 8; WOODFORD, Ibis, 1916, p. 118, pl. 3.
Type, *Woodfordia superciliosa* NORTH.....[*Meliphagidae?*[2]]
(Monotypy.)
For Charles Morris Woodford, 1853– (North.)

Xanthocincla JERDON, Madras Journal Lit. and Sci., vol. 10, 1839, p. 255.
Emendation of *Ianthocincla* GOULD.....[*Turdoididae.*]

[*Xanthogenius* "Bp." of Waterhouse (Index, p. 234) is a specific name with Bonaparte!]

Xanthomyias BERLEPSCH, Proc. Fourth Intern. Orn. Congress (Ornis, vol. 14), February, 1907, p. 490.
Type, *Muscicapa virescens* TEMMINCK.....[*Tyrannidae.*]
(Original designation.)

Xenocopsychus HARTERT, Bull. Brit. Orn. Club, vol. 19, No. 134, May 28, 1907, p. 81; Novit. Zool., vol. 16, 1909, p. 333, pl. 14, fig. 1.
Type, *Xenocopsychus ansorgei* HARTERT.....[*Turdidae.*]
(Monotypy.)

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[1] At the end of the article (p. 617) the writer says: "Dr. Leach was perfectly right, in removing this very singular species from the genus *Parus*, and forming of it a separate division."

[2] North places this genus near *Melidectes* and *Melipotes*, but Sharpe thought it belonged in the Zosteropidae (Handlist, vol. 5, p. 632).

Xiphidiopipo SUNDEVALL, Conspectum Avium Picinarum, 1866, p. 115.
Emendation of *Xiphidiopicus* BONAPARTE, 1854.....[*Picidae.*]

Xylocota BONAPARTE, Iconogr. Fauna Italica, vol. 1, 1839 (fasc. 25), text to pl. [43].
Type, *Scolopax paludosa* GMELIN [=*Scolopax undulata* BODDAERT].
[*Scolopacidae.*]
(Original designation.)

Xylopicus "Cab." REY, Synon. Eur. Brutvögel und Gäste, 1872, p. 246.
Equivalent to *Hylocopus* CABANIS and HEINE, 1863.....[*Picidae.*]

Xylopogon "Temm., ms." LESSON, Revue Zoologique, vol. 3, 1840, p. 134.
Cited as a synonym of *Caloramphus* LESSON.....[*Capitonidae.*]

†**Yalavis** SHUFELDT, Journal of Geology, vol. 21, No. 7, October–November, 1913, p. 649.
Type, *Yalavis tenuipes* SHUFELDT.....[*Incertae sedis.*[2]]
(Monotypy.)
"Yale and *avis;* the University at New Haven, Conn., U. S. A., and *avis*, a bird."[1]
(Shufeldt.)

Ypsilophorus MATHEWS, Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, p. 127.
New name for *Synoicus* GOULD, 1837 (not *Synoicum* PHIPPS, 1774).
[*Phasianidae.*]
Υ ψιλόν (Upsilon, Greek Υ); φορέω, I bear, carry. (Mathews, MS.)

Zanda MATHEWS, Austral Avian Record, vol. 1, No. 8, Mar. 20, 1913, p. 196.
Type, *Calyptorhynchus baudini tenuirostris* MATHEWS.....[*Cacatoidae.*]
(Original designation and monotypy.)
Zanda, an aboriginal name. (Mathews, MS.)

Zarapita MATHEWS, Birds of Australia, vol. 3, pt. 2, May 2, 1913, p. 168.
Type, *Numenius tenuirostris* VIEILLOT.....[*Scolopacidae.*]
(Original designation and monotypy.)
Zarapito, Spanish name of a curlew. (Mathews, MS.)

Zoonava MATHEWS, Austral Avian Record, vol. 2, No. 5, Sept. 24, 1914, p. 112.
Type, *Cypselus terræreginæ* RAMSAY.....[*Micropodidae.*]
(Original designation and monotypy.)
Zoonav, an aboriginal name. (Mathews, MS.)

[1] *Xylocota* at 1839 will displace *Homoptilura* Gray, 1840, in Mr. Mathews's recent subdivision of the group (Birds Australia, vol. 3, 1913, p. 287).
[2] A small passerine bird, of the size of a *Dendroica*.

CATALOGUE OF GENERA MENTIONED IN THE FOREGOING LIST, ARRANGED BY FAMILIES.

[Fossil genera are indicated by italics.]

INCERTAE SEDIS.
- *Cathartornis.*
- Cornix.
- *Cypselavus.*
- *Hebe.*
- *Limosavis.*
- *Meleagrops.*
- *Odontornis.*
- *Palæolestes.*
- *Palæophasianus.*
- Pecoris.
- *Pleistogyps.*
- *Plioaetus.*
- *Proictinia.*
- Stenura.
- *Strigogyps.*
- *Teratornis.*
- *Yalavis.*

ALAUDIDAE.
- Amirafra.
- Chionophilos.
- Heteromirafra.
- Heteronyx.
- Melanocoryphoides.
- Niphophilos.
- Otocorydopsis.
- Pseudalaudula.
- Pyrgilauda.
- Razocorys.

ALCEDINIDAE.
- Alcyon.
- Micralcyone.

ALCIDAE.
- Alcella.
- Chenalopex.
- Plautus.

AMPELIDAE.
- Garrulus.
- ?Phlogenys.

ANATIDAE.
- Clangocycnus.
- Ctenanas.
- Cyanochen.
- Cygnus.
- Lophonetta.
- Merganas.
- Phæonetta.
- Promergus.
- Raphipterus.

ARDEIDAE.
- *Botauroides.*
- *?Eoceornis.*
- Erogas.
- Hemigarzetta.
- Myola.
- Tigribaphe.
- Toburoides.
- Tonophoyx.

ARENARIIDAE.
- Morinella.

ARTAMIDAE.
- Angroyan.
- Austrartamus.
- Campbellornis.
- Micrartamus.
- Pseudartamus.

BUBONIDAE.
- (See Strigidae.)

BUCCONIDAE.
- Ecchaunornis.

BUTEONIDAE.
- Aëtos.
- Buteaëtos.
- Circobuteo.
- Clanga.
- Euaquila.
- Eucircus.
- Eunisus.
- Fringillarius.
- Harpe.
- Hypaëtos.
- Ictiniastur.
- Limnosalus.
- Paraspizias.
- Phalcobœnus.

CACATOIDAE.
- Alisterus.
- Harrisornis.
- Megapsittacus.
- Zanda.

CAMPEPHAGIDAE.
- Acanthinotus.
- Coquus.
- Karua.
- Malindangia.
- Metagraucalus.
- Motacilloides.
- Paragraucalus.

CAPITONIDAE.
Calorhynchus.
Dicrorhynchus.
Xylopogon.
CAPRIMULGIDAE.
Antiurus.
Capripeda.
Nyctiphrynus.
Nyctipolus.
Nyctiprogne.
Nyctivociferator.
Ptilonycterus.
Ramphaoratus.
Setochalcis.
Setopagis.
Systellura.
Thermochalcis.
Uropsalis.
Vociferator.
CASUARIIDAE.
Cassowara.
CATHARTIDAE.
(See Vulturidae.)
CERTHIIDAE.
Neoclima.
Whitlocka.
CHARADRIIDAE.
Afribyx.
Afroxyechus.
Elseya.
Elseyornis.
Eupodella.
Helenægialus.
?Limicolavis.
Nomusia.
Pagoa.
Pagolla.
Paroxyechus.
Pernettyva.
Rogibyx.
CHIONIDIDAE.
Necrophagus.
CICONIIDAE.
Argala.
Dipluravis.
Ibis.
Jabiru DUMONT.
Jabiru HELLMAYR.
CLARAVIIDAE.
Eupelia.
Gallicolumba.
Leptophaps.
Lophaon.
Terraphaps.
Turtur.
COLUMBIDAE.
Columbigallus.
Livia.
Noticœnas.
Rupicola.
Sylvicola.
COLYMBIDAE.
Phalaropsis.
CORVIDAE.
Boanerges.
Cyanocorvus.
Frugilegus.
Hellmayria.
Laletris.
Lalocitta.
Neostrepera.
Picathartes.
Podoces.
COTINGIDAE.
Ampeleia.
Polachio.
Psalidura.
Schizura.
CRACIDAE.
Penelops.
Penelopsis.
CRATEROPODIDAE.
(See Turdoididae.)
CUCULIDAE.
Melanococcyx.
Micrococcyx.
Neochalcites.
Owenavis.
Tapera.
CURSORIIDAE.
Subglareola.
CYCLOPSITTACIDAE.
?Manopsitta.
Pseudopsittacus.
DICAEIDAE.
Austrodicæum.
Nesopardalotus.
Pardalotinus.
DIDIDAE.
(See Raphidae.)
DINORNITHIDAE.
Megalornis.
Palæocasuarius.
DIOMEDEIDAE.
Diomedella.
Nealbatrus.
DREPANIDIDAE.
Psittacina.
Psittacopis.

DROMADIDAE.
Pachyrhinchus.
DROMICEIIDAE.
Peronista.
EULABETIDAE.
(See Graculidae.)
FALCONIDAE.
Cenchris.
Dorcadothera.
Eufalco.
Gyrfalco.
Lanarius.
Notofalco.
Pontotriorchis.
FORMICARIIDAE.
Hylopezus.
Hylophylax.
Megastictus.
Myrmoderus.
Myrmopagis.
Myrmorchilus.
Oropezus.
Phænostictus.
Pithys.
Rhoporchilus.
FRINGILLIDAE.
Cactospiza.
Canaria.
Cannabis.
Chloreus.
Citrinella.
Cryptophaga.
Fringilloides.
Hylospingus.
Leptonyx.
Linaria.
Oberholseria.
Onychospiza.
Oreospiza.
Pityornis.
Platyspiza.
Pogonospiza.
Poliospina.
Protopyrrhula.
Pseudacanthis.
Tisa.
FURNARIIDAE.
Acrorchilus.
Anabatoides.
Chilia.
Drioctistes.
Hyloctistes.
Microxenops.
Parulus.
FURNARIIDAE—Continued.
Phacellodomus.
Premnornis.
Rhopoctites.
Schoeniophylax.
GALBULIDAE.
Psilopornis.
GOURIDAE?
Progura.
GRACULIDAE.
Mainatus.
Metallopsar.
GRUIDAE.
(See Megalornithidae.)
GYPOGERANIDAE.
(See Sagittariidae.)
HAEMATOPODIDAE.
Prohæmatopus.
HIRUNDINIDAE.
Chelidonia.
Hemicecrops.
Pristoptera.
Tapera.
IBIDIDAE.
(See Threskiornithidae.)
ICTERIDAE.
Chopis.
Gnorimopsar.
Sciopsar.
INDICATORIDAE.
Eriocleptes.
Melichneutes.
IRRISORIDAE.
Cyanepops.
JACANIDAE.
Irediparra.
LANIIDAE.
Aenopogon.
Caudolanius.
Lanarius.
Leucopterus.
Melloria.
LARIDAE.
Alphagygis.
Anousella.
Chlidonias.
Gygisterna.
Leucanous.
Plautus.
Polocandora.
Pontochelidon.
Sternolophota.

LORIIDAE.
Eutelipsitta.
Oenopsittacus.
Ptilosclera.
MEGALORNITHIDAE.
Mathewsena.
Mathewsia.
MEGAPODIDAE.
Megathelia.
MELEAGRIDAE.
Eumeleagris.
MELIPHAGIDAE.
Amoromyza (p. 593).
Broadbentia.
Caloptilotis.
Coleia.
Dorothina.
Dyottornis.
Grantiella.
Gymnomyza.
Hemiptilotis.
Lacustroica.
Lophoptilotis.
Macgillivrayornis.
Melomyza.
Microphilemon.
Microptilotis.
Neophilemon.
Nesoptilotis.
Notiomystis.
Oreornis.
Paraptilotis.
Ptilotina.
Ptilotula.
Purnella.
Purnellornis.
Ramsayornis.
Sacramela.
Thelazomenus.
Trichodere.
Woodfordia.
MENURIDAE.
Harriwhitea.
MESITIDAE.
Mesitornis.
MICROPODIDAE.
Achantylops.
Aerodramus.
Mearnsia.
Pallenia.
Reinarda.
Streptoprocne.
Zoonava.
MIMIDAE.
Lucar.
MNIOTILTIDAE.
Agreocantor.
Azuria.
Caeruleocantor.
Erythrosoma.
Fruticantor.
Frutiornis.
Limnothlypis.
Lineocantor.
Maculocantor.
Piceacantor.
Pinacantor.
Sylviocantor.
Terracantor.
Vireocantor.
MOTACILLIDAE.
Austranthus.
MUSCICAPIDAE.
Alisternornis.
Arfakornis.
Belchera.
Camiguinia.
Carternornis.
Cyanonympha.
Ethelornis.
Gilbertornis.
Hapolorhynchus.
Howeavis.
Iredaleornis.
Kempia.
Kempiella.
Lewinornis.
Littlera.
Maorigerygone.
Mattingleya.
Microbainopus.
Muscicapella.
Nesomiro.
Pseudocalyptomena.
Quoyornis.
Royigerygone.
Setosura.
Sheppardia.
Submyiagra.
Subsmicrornis.
Tregellasia.
Whiteornis.
Wilsonavis.
NECTARINIIDAE.
Dreptes.
Toxorhamphus.
ORIOLIDAE.
Amimeta.

OTIDIDAE.
Ardeotis.
Austrotis.
PARADISAEIDAE.
Neoparadisea.
Pseudastrapia.
PARIDAE.
Neosuthora.
Vagans.
PERISTERIDAE.
(See Claraviidae.)
PHAËTHONTIDAE.
Leptophaethon.
Scæophaethon.
PHALACROCORACIDAE.
Cormoranus.
Graucalus.
Mesocarbo.
PHASIANIDAE.
Acomus.
Anurophasis.
Caloperdix.
Chacura.
Chrysolophus.
Cryptoplectron.
Cyanophasis.
Gnathodon.
Maroturnia.
Microplectron.
Nycthemerus.
Paraortyx.
Peloperdix.
Phoenicoperdix.
Rubicola.
Tetraoperdix.
Ypsilophorus.
PICIDAE.
Alophus.
Balanosphyra.
Calopicus.
Chryserpes.
Chrysopterus.
Colombpicus.
Dolichopicos.
Dryotomus.
Gauropicoides
Geocolaptes.
Hyloscopus.
Leucopicus.
Linneopicus.
Megalopipo.
Melanopicos
Meropicus.
Mesospilus.
PICIDAE—Continued.
Neophloeotomus.
Phlœonerpes.
Picumnoides.
Tridactylocolaptes.
Verreauxia.
Xiphidiopipo.
Xylopicus.
PITTIDAE.
Austropitta.
PLOCEIDAE.
Alisteranus.
Bolbospiza.
Chera.
Erythrina.
Ficophaga.
Heliospiza.
Heteromunia.
Hyphantornis.
Neopœphila.
Paludipasser.
Senegalus.
Sporothlastes.
PODARGIDAE.
Megapodargus.
Micropodargus.
PRIONOPIDAE.
Alphacincla.
Bowyeria.
Caleya.
Conigravea.
PROCELLARIIDAE.
Bannermania.
Fregettornis.
Fulmariprion.
Heteroprion.
Nesofregetta.
Petrella.
PSITTACIDAE.
Amoropsittaca.
Bolborhynchus.
Diopsittaca.
Grammopsittaca.
Hapalopsittaca.
Nannopsittaca.
Neonanodes.
Neopsephotus.
Northiella.
Northipsitta.
Ognorhynchus.
Orthopsittaca.
Primolius.
Psephotellus.
Psilopsiagon.
Thectocercus.

PTEROPTOCHIDAE.
Myornis.
PTILONORHYNCHIDAE.
Alphachlamydera.
Rogersornis.
PUFFINIDAE.
Alphapuffinus.
Calonectris.
Cinathisma.
Hemipuffinus.
Microzalias.
Neonectris.
Reinholdia.
PYCNONOTIDAE.
Hemitarsus.
RALLIDAE.
Creccopus.
Hæmatornis.
Mantellornis.
Porzanoides.
Ralloides.
Tomirdus.
RAMPHASTIDAE.
Bauharnaisius.
RAPHIDAE?
Apterornis.
REGULIDAE.
Regulus.
SAGITTARIIDAE.
Amphiserpentarius.
Sagittarius.
SCOLOPACIDAE.
Anteliotringa.
Calidris.
Canutus.
Chubbia.
Cinclus.
Ditelmatias.
Eugallinago.
Homoscolopax.
Machophilus.
Macrodura.
Neopisobia.
Neospilura.
Odurella.
Parascolopax.
Rubicola.
Rusticola.
Subspilura.
Tringoides.
Vetola.
Xylocota.
Zarapita.
SITTIDAE.
Neositta.
Orthorynchus.
Rupisitta.
SPHENISCIDAE.
Hyponectes.
STEGANOPODES?
Elopteryx.
STERCORARIIDAE.
Atalolestris.
STEREORNITHES.
Pseudogavia.
STRIGIDAE.
Glaux.
Microscops.
Minerva.
Noctua.
Rhodoglaux.
Stringonax.
STRUTHIONES.
Psammornis.
STURNIDAE.
Cossyphus.
Lamprolophos.
Leucopsar.
Nabouroupus.
Nomadites.
Onychoramphus.
Spreo.
Stilbo.
SULIDAE.
Hemisula.
Parasula.
Sulita.
SYLVIIDAE.
Aëdonops.
Aëdonopsis.
Blythoscopus.
Cettia.
Corytholaea.
Dulciornis.
Eyramytis.
Hallornis.
Hemiellisia.
Leggeornis.
Luscinioides.
Maccoyornis.
Magnamytis.
Melophilus.
Milligania.
Mytisa.
Neosericornis.
Nesomalurus.
Olivetra.

SYLVIIDAE—Continued.
Origmella.
Philacantha.
Philomelopsis.
Pholidornis.
Rosina.
Ryania.
Salicaria.
Sterparola.
Tasmanornis.
TANGARIDAE.
Chrysothlypis.
Compsothraupis.
Erythrothlypis.
Merula.
TETRAONIDAE.
Hylobrontes.
Palaeobonasa.
THRESKIORNITHIDAE.
Bostrychia.
Ibilophus.
Oreoibis.
Setibis.
TIMALIIDAE.
Graueria.
Macrorthonyx.
Morganornis.
Myophonus.
Pseudopitta.
Samuela.
Saxicoloides.
Sittina.
Tychaëdon (p. 575).
TINAMIDAE.
Crypturellus.
Tinamus.
TRERONIDAE.
Erythrolæma.
Hæmatæna.
Jambotreron.
Pterocolpa.
Raperia.
Reginopus.
TROCHILIDAE.
Aline.
Amazilina.
Ariadne.
Corinnes.
Cyanolæmus.
Euphasia.
Goethalsia.
Goldmania.
Loddigesia.
Microstilbon.
Nesophlox.
Taphrospilus.
TROGLODYTIDAE.
Odontorchilus.
TROGONIDAE.
Chrysotrogon.
Microtrogon.
TURDIDAE.
Ashbyia.
Aurepthianura.
Merula.
Merulissima.
Oroscirtetes.
Parepthianura.
Philomeloïdes.
Pseudaëdon.
Rubecula.
Streptocichla.
Torrentaria.
Xenocopsychus.
TURDOIDIDAE.
(Crateropodidae of authors.)
Pengia.
Turdoides.
Xanthocincla.
TURNICIDAE.
Alphaturnia.
Austroturnix.
Colcloughia.
TYRANNIDAE.
Anomalopterus.
Colonia.
Coryphotriccus.
Guracava.
Idioptilon.
Inezia.
Oreomyias.
Oreotriccus.
Prædo.
Pseudocolopteryx.
Semnarchus.
Snethlagea.
Xanthomyias.
TYTONIDAE.
Flammea.
Glaucostrix.
VIREONIDAE.
Chlorochroa.
VULTURIDAE.
(Cathartidae of authors.)
Coragyps.
Gallinaza.
Plesiocathartes.
ZOSTEROPIDAE.
Nesozosterops.

NORTH AMERICAN COLLEMBOLOUS INSECTS OF THE SUBFAMILY ONYCHIURINAE.

By Justus W. Folsom,
Of the University of Illinois, Urbana, Illinois.

Among our most abundant collembolans are species of *Onychiurus*. They are white (one species having a yellow variety), elongate (pl. 68), usually 1 or 2 millimeters in length, nonsaltatorial; they belong essentially to the fauna of the soil and are limited to damp situations.

The subfamily Onychiurinae comprises three genera: *Onychiurus*-*Tullbergia*, represented in North America by a single Californian species; and *Tetrodontophora*, a European genus with one described species.

The forms discussed in this article are:

Onychiurus similis, new species.
Onychiurus cocklei Folsom.
Onychiurus subtenuis, new species.
Onychiurus litoreus, new species.
Onychiurus armatus Tullberg.
Onychiurus pseudarmatus, new species.
Onychiurus octopunctatus Tullberg.
Onychiurus dentatus Folsom.
Onychiurus ramosus, new species.
Onychiurus fimetarius Linnaeus, Lubbock.
Onychiurus pseudofimetarius, new species.
Tullbergia collis Bacon.

These are all the species of the subfamily that are at present known in our fauna. I expect, however, that many more species will be brought to light. In Europe *armatus*, *fimetarius*, and *ambulans* are everywhere abundant. In North America the first two species are widely distributed, but *ambulans* is unknown in collections. Packard ('73) recorded *ambulans* from Washington, but his specimens are lost, and his description is broad enough to include almost any of our species with anal spines. Subsequent records of the occurrence of *ambulans* in this country have either followed Packard or have been based upon misidentifications. *Ambulans*

is to be looked for, however, especially along the Atlantic coast. In eastern Massachusetts, for example, there are many European species of Collembola that fail to appear in extensive collections from Illinois, Ohio, and New York.

Cotypes and other specimens have been deposited in the United States National Museum, Washington, District of Columbia; and in the Museum of Comparative Zoology, Cambridge, Massachusetts.

Order COLLEMBOLA Lubbock

Suborder ARTHROPLEONA Börner

Family PODURIDAE Lubbock

Subfamily ONYCHIURINAE Börner

Aphorurini BÖRNER '01*a*.
Aphorurinae BÖRNER '01*b*.
Onychiurinae BÖRNER '01*c*, '06.

Pseudocelli present. Eyes absent. Postantennal organs present in most species and usually well developed. Antennal base usually present, distinguished by tubercles smaller than those of the rest of the head. Third antennal segment with a characteristic distal lateral sense organ, consisting of two or three sense clubs, a pair of sense rods, and usually outer papillae with their guard setae. Mouth parts mandibulate; mandibles with apical incisive teeth and with a many-toothed molar surface. Furcula absent, except in genus *Tetrodontophora*. Anal spines present or absent. Tarsi with one or two claws. Clavate tenent hairs absent. Integument tuberculate.

KEY TO GENERA OF ONYCHIURINAE.

Furcula absent. Postantennal organs almost always present. Papillae of sense organ of third antennal segment almost always present, but not more than ten.

Body stout or moderately slender. Head broad. Tubercles of postantennal organs usually not numerous; simple, or compound. Unguiculus present. Sense clubs of third antennal segment two, straight or feebly bent, smooth, granulate, or tuberculate, not curving toward each other; papillae usually four or five (0–10), with usually the same number of guard setae. Fourth antennal segment with subapical papilla and usually without apical sense club..*Onychiurus* Gervais, Börner, p. 639.

Body quite slender. Head narrow. Tubercles of postantennal organs usually numerous, always simple. Unguiculus present or absent. Sense clubs of third antennal segment two or three, smooth, curving toward each other, with commonly an accessory ventro-lateral isolated sense club; papillae present (two or three), absent, or represented by a cuticular ridge. Guard setae two to four. Fourth antennal segment without subapical papilla, with apical sense club..... *Tullbergia* Lubbock, Börner, p. 651.

Furcula present. Postantennal organs absent. Papillae of sense organ of third antennal segment 14 or 15 in number..... *Tetrodontophora* Reuter, p. 652.

Genus ONYCHIURUS Gervais, Börner.

Podura Linnaeus 1758 (part).
Lipura Burmeister 1838.
Onychiurus Gervais 1841. (See Gervais 1844, p. 397.)
Anurophorus Nicolet 1841 (part).
Adicranus Bourlet 1842 (part).
Aphorura MacGillivray 1893.
Onychiurus Börner 1901c, 1909.

Including also the subgenera *Protaphorura*, *Deutaphorura*, and *Kalaphorura* (Absolon 1901*b*), and the sections *Euaphorura* and *Absolonia* (Börner 1901*b*).

Body stout or moderately slender. Head relatively large; broader than, or a little narrower than, the prothorax. Antennal base well defined. Postantennal organs (rarely absent) each in a transverse groove, close to the antennal base, with relatively large tubercles, occasionally about fifty in number, but usually not numerous; and simple, tuberculate, or lobed. Sense organ of third antennal segment with usually four or five (0–10) papillae, with guard setae, a pair of sense rods, and two straight or feebly bent sense-clubs, which are smooth, granulate, or tuberculate, and do not curve toward each other. Tarsus with two claws. Furcula absent; represented in a few species by an integumental fold or by a pair of rudimentary mucrodentes on the fourth abdominal segment; in the latter instance the tenaculum also may be represented. Anal spines 0–4, with or without papillae. Fourth antennal segment usually with curving sensory setae and with subapical papilla; usually without apical sense club.

KEY TO SPECIES OF ONYCHIURUS.

1. Anal spines absent. Tubercles of postantennal organs compound.....
   Anal spines present..... 3
2. Body stout. Antennal organ with four papillae and two ovate erect sense clubs.....*fimetarius*, p. 649
   Body slender. Antennal organ with five papillae and two subreniform oblique sense-clubs.....*pseudofimetarius*, p. 650
3. Tubercles of postantennal organs simple..... 4
   Tubercles of postantennal organs compound.....10
4. Postantennal organs elongate-elliptical with about 18–44 closely set tubercles... 5
   Postantennal organs with about 8–14 separated tubercles..... 8
5. Pseudocelli of antennal bases 3+3..... 6
   Pseudocelli of antennal bases 2+2 or 4+4..... 7
6. Tubercles of postantennal organ not crowded together. Pseudocelli of antennal base arranged in a triangle; those of the fifth abdominal segment in a straight line on each side. Unguiculus as long as the unguis.....*armatus*, p. 644
   Tubercles of postantennal organ crowded together. Pseudocelli of antennal base almost in a straight line; those of the fifth abdominal segment in a triangle on each side. Unguiculus much shorter than unguis.....*pseudarmatus*, p. 646
7. Pseudocelli of antennal bases 2+2. Postantennal organ with about 20 tubercles.....*litoreus*, p. 644
   Pseudocelli of antennal bases 4+4. Postantennal organ with about 33–37 tubercles.....*octopunctatus*, p. 647

8. Pseudocelli of antennal bases 2+2, rarely 3+3.....*subtenuis*, p. 642
Pseudocelli of antennal bases 1+1..... 9
9. Anal spines contiguous. Sense clubs of antennal organ subovate, oblique. *similis*, p. 640
Anal spines separated. Sense clubs of antennal organ disklike, erect.*cocklei*, p. 640
10. Tubercles of postantennal organs distinctly branched (fig. 76). Anal papillae large.....*ramosus*, p. 648
Tubercles of postantennal organs with hundreds of closely set papillae (fig. 65). Anal papillae reduced to rings.....*dentatus*, p. 647

ONYCHIURUS SIMILIS, new species

Plate 68, fig. 1; plate 70, figs. 12–18.

White. Body slender (fig. 1). Postantennal organs (fig. 12) each with eight to ten simple tubercles. Pseudocelli of antennal bases (fig. 1) 1+1. Posterior border of head without pseudocelli. Antennae shorter than the head. Sense organ of third antennal segment (fig. 13) with five slender papillae, four guard-setae, a pair of sense rods and two sense clubs, each consisting of a coarsely tuberculate ovate head attached obliquely to its stalk. Dorsal pseudocelli of body (fig. 1) successively: 0, 1+1, 1+1, 1+1, 1+1, 1+1, 1+1, 2+2, 0; those of the fifth abdominal segment being in two oblique pairs. Unguis (fig. 14) slender, curving, untoothed. Unguiculus about one-half as long as unguis; basal half broadly lamellate, apical half acuminate. Anal spines (figs. 15, 16) two, stout, arcuate, subequal to, or a little shorter than, hind ungues, on low contiguous papillae Supra-anal lobe rounded (fig. 15). Clothing (fig. 17) of sparse short curving setae and few longer and stiffer setae. Cuticular tubercles small (fig. 18). Length, 1.2 mm.

This species is close to *cocklei*, from which it may be distinguished by the following key:

Body slender; unguiculus one-half as long as unguis; anal papillae contiguous; anal segment as in figure 15; papillae of antennal sense organ slender, sense clubs subovate and oblique; cuticular tubercles small.....*similis*.
Body not slender; unguiculus two-thirds as long as unguis; anal papillae separated; anal segment as in figure 23; papillae of antennal sense organ stout, sense clubs disklike and erect; cuticular tubercles large.....*cocklei*.

Abundant under damp logs, Homer, Illinois, November 25.
Cotypes.—Cat. No. 20763, U.S.N.M.

ONYCHIURUS COCKLEI Folsom.

Plate 68, fig. 2; plate 70, figs. 19, 20; plate 71, figs. 21–28.

Aphorura cocklei Folsom, 1908.
Aphorura montis Bacon, 1913.
Aphorura lutea Bacon, 1913.

White or lemon-yellow; rather slender (fig. 2). Postantennal organs (fig. 19) with 8 to 11 simple tubercles, which are usually ovate,

elliptical or oval. Pseudocelli of antennal bases 1+1 (fig. 20). Antennae as long as, or slightly shorter than, the head. Sense organ of third antennal segment (fig. 21) with five papillae, four guard setae, a pair of sense rods, and two sense clubs, each with a stout stalk supporting a coarsely papillate disk. Dorsal pseudocelli of body segments successively: 0, 1+1, 1+1, 1+1, 1+1; 1+1, 1+1, 2+2, 0; those of the fifth abdominal segment being in two oblique pairs. Unguis (fig. 22) stout, feebly curving, untoothed. Unguiculus two-thirds as long as unguis, with sublanceolate basal lamella and acuminately prolonged apex. Anal spines two (figs. 23, 24) stout, arcuate, subequal in length to hind ungues, on prominent separated papillae. Clothing (figs. 25, 26, 27) of sparse short curving setae and fewer but longer stiff setae. Cubicular tubercles large (fig. 28). Maximum length, 2 mm.

The papillae of the antennal organ vary considerably in form; they are usually stout, and rounded or subconical, though sometimes reduced and toothlike; in one instance, six papillae occurred as an abnormality, with the usual four guard-setae. There is some variation in the clothing, as indicated in figures 26 and 27. The cuticular tubercles are larger than in any other of our species of *Onychiurus*.

Aphorura montis Bacon and *A. lutea* Bacon are synonymous with *A. cocklei* Folsom, as I have found from a study of several cotypes given to me by Mrs. Gertrude Bacon Chaffee.

This species was discovered by Mr. J. W. Cockle in Kaslo, British Columbia, at an altitude of 2,250 feet, where it occurred in masses so dense as to cover the snow with a carpet of gold over patches of several square yards. Some of the specimens found by Mr. Cockle were white instead of yellow.

In southern California at Bear Flats, on the slope of Mount San Antonio, at an elevation of 6,000 feet, Dr. W. A. Hilton and Miss G. A. Bacon found thousands of these insects in moist soil in a very limited area, white forms and yellow forms of all sizes occurring together; the yellow variety being, however, the more abundant.

My specimens from Oregon were taken on melting snow and under wood on moist ground.

British Columbia: Kaslo, January 31, February 23, March, J. W. Cockle.

Washington: L. Bremner (Stanford Univ.).

Oregon: Hilgard, March 4, W. A. Newcombe. Corvallis, December 25, H. E. Ewing.

California: Mount San Antonio, April, W. A. Hilton, G. A. Bacon.

Cotypes.—Cat. No. 12033, U.S.N.M.

ONYCHIURUS SUBTENUIS, new species.

Plate 68, fig. 3; plate 72, figs. 29–38.

White, elongate; abdomen but slightly broader than the thorax, tapering posteriorly (fig. 3). Postantennal organs (figs. 29, 30) each with 8 to 14, usually 11 to 13, tubercles, simple or occasionally biramous. Pseudocelli of antennal bases 2+2 or 3+3, arranged side by side (fig. 31). Base of head without pseudocelli. Antennae shorter than the head, with segments about as 3:3:5:8 in relative lengths. Sense organ of third antennal segment (fig. 32) with five elongate papillae, five guard setae, a pair of subclavate sense rods, and two capitate sense clubs, coarsely tuberculate. Dorsal pseudocelli of body (fig. 3) typically 0, 1+1, 1+1, 1+1, 1+1, 0, 2+2, 3+3, 0. Thus pseudocelli are absent normally on the prothorax and on the third and the sixth abdominal segments. One of the two pseudocelli is frequently absent on the first or the second abdominal segment (see beyond under variation). The pseudocelli of the fourth abdominal segment are in two oblique pairs. Those of the fifth abdominal segment are sometimes 4+4 instead of 3+3, the pseudocelli of each group being close together and in oblique alignment. Lateral and ventral pseudocelli are absent. Unguis (fig. 33) stout, curving, with inner margin unidentate one-third from the base. Ungiculus extending two-thirds as far as the unguis, subelliptically lamellate basally and acuminate apically. Anal spines (figs. 34, 35, 36) two, half as long as hind ungues, curving, on stout contiguous papillae about one-fourth as long as the spines. Supra-anal lobe (fig. 34) tapering, projecting far behind the infra-anal lobes. Clothing (fig. 37) of numerous feebly-curving setae of moderate length, interspersed with fewer longer and stiffer setae. Cuticular tubercles small (fig. 38). Maximum length, 2 mm.

Variation.—One small specimen, 1 millimeter in length, had 8 postantennal tubercles on the right side; another of the same length had, however, 11.

The pseudocelli of the antennal bases are 2+2 in all the Illinois specimens that I have seen; but in some of the specimens from New York and Pennsylvania there are 3+3 (fig. 31). Furthermore, the pseudocelli of the fifth abdominal segment, typically 3+3, show the variation 4+4 in some of the material from New York and Pennsylvania.

The pseudocelli of the first and second abdominal segments vary persistently in number, one of each pair being usually absent. The variations in 50 specimens taken at random fall into the following categories:

	Left.	Right.	Left.	Right.	Left.	Right.	Left.	Right.	Left.	Right.
Abd. 1	....	....	0	1	1	0	1	0	0	1
Abd. 2	....	....	0	1	1	0	0	1	1	0
Examples	....	....	15		11		7		4	
Abd. 1	....	....	0	1	0	0	1	1	1	×
Abd. 2	....	....	0	0	1	0	0	0	1	×
Examples	....	....	4		1		1		1	
Abd. 1	1	×	1	1	1	0	0	0	0	0
Abd. 2	×	×	1	0	0	0	0	1	0	0
Examples	1		1		1		2		1	

In a few instances pseudocelli were present in a rudimentary condition, as indicated by × in the foregoing tables.

These tables show that both pseudocelli on the left side were lacking in 30 per cent of the specimens and those of the right side in 22 per cent.

On finding these variations I examined some 80 specimens in search of the normal condition (1+1 on both segments), but failed to find a specimen that was not abnormal in material from Champaign County, Illinois, from several localities, some of which were 12 miles apart. The few specimens that I had from New York State also showed the same kind of variation. Of 15 specimens from Pennsylvania, however, 14 were abnormal and one was normal, having a pair of pseudocelli on each of the first two abdominal segments.

Schäffer ('96, p. 162) has recorded the fact that certain variations in the distribution of the pseudocelli appear sometimes to characterize entire colonies. He found that a large number of individuals of *Onychiurus armatus* from a single locality all lacked the pseudocelli of the mesothorax and of the third abdominal segment. In the case of *O. subtenuis*, however, the variation is not limited to a single locality, but occurs in 99 per cent of all the specimens from three States, the form regarded as "normal" being in fact extremely rare. The species exhibits primarily a strongly inherited variability of the pseudocelli of the first and second abdominal segments, and secondly a wide range of individual variation in the distribution of the pseudocelli on these segments.

The tooth of the unguis varies in size and is absent in some of the specimens from Pennsylvania. The setae of the body are somewhat longer in specimens from New York than in those from Illinois.

This species occurs abundantly under logs or dead leaves on damp soil.

New York: Near Keuka Lake, October 31, C. R. Crosby.

Pennsylvania: Harrisburg, November 14, H. A. Surface.

Illinois: Homer, April 2, 3, 9, May 7, 8, June 6, November 7, 25; Urbana, February 19, March 13, 17, April 5, 11, 12, 18, 19, 25, May 3.

Cotypes.—Cat. No. 20764, U.S.N.M.

ONYCHIURUS LITOREUS, new species.

Plate 68, fig. 4; plate 73, figs. 39–42.

White. Postantennal organs (fig. 39) elliptical, each with about 20 simple tubercles. Pseudocelli of antennal bases 2+2, in pairs. Base of head with 2+2 pseudocelli, in oblique pairs. Antennae shorter than the head. Sense organ of third antennal segment with five papillae, five guard setae, two ovate papillate sense clubs and probably two sense rods. Dorsal pseudocelli of body (fig. 4) 1+1 on segments one to six, inclusive; 2+2 in oblique pairs on segment seven; 3+3 on segment eight, as follows: 2+2 posterior, in oblique pairs, and 1+1 antero-lateral; pseudocelli absent on segment nine. Postero-lateral pseudocelli 1+1 on each of the first three abdominal segments. Unguis (fig. 40) long, slender, strongly curving, untoothed. Unguiculus extending less than half as far as the unguis, lamellate, with straight outer margin and short acuminate apex. Anal spines (fig. 41) two, half as long as hind ungues, stout, feebly curving, on widely separated papillae, which are half as long as the spines. Clothing of sparse minute setae, becoming longer posteriorly. Cuticular tubercles minute (fig. 42). Length, 1.3 mm.

Neponset, Massachusetts, May 4, October 10, 20, on the seashore between tide marks, under stones with *Anurida maritima*.

The cotypes of this species are in the author's collection at present.

ONYCHIURUS ARMATUS Tullberg.

Plate 68, fig. 5; plate 73, figs. 43–51.

Lipura armata Tullberg, 1869, 1871, 1872, 1876.—Lubbock, 1873.—Reuter, 1876, 1890, 1895.—Uzel, 1890, 1891.—MacGillivray, 1891.—Schött, 1894 *a*.—Lie-Pettersen, 1896, 1898.—Carpenter and Evans, 1899.—Willem, 1900.—Evans, 1901.

Lipura arctica Tullberg, 1876.—Schäffer, 1894.—Schött, 1894 *a*.—Lie-Pettersen, 1898.—Lubbock, 1898.

Lipura ambulans Meinert, 1896.

Aphorura armata Schäffer, 1896, 1897, 1900*a*, 1900*b*.—Poppe and Schäffer, 1897.—Scherbakow, 1898.—Carl, 1899, 1901.—Absolon, 1900*a*, 1900*b*.—Wahlgren, 1900*a*, 1900*b*.—Börner, 1901*b*, 1901*d*.—Krausbauer, 1902.

Aphorura arctica Scherbakow, 1899*a*, 1899*b*.—Wahlgren, 1899, 1900*a*, 1900*b*.—Axelson, 1900.—Schäffer, 1900*b*.—Skorikow, 1900.

Onychiurus armatus Börner, 1902*a*, 1907.—Voigts, 1902.—Ågren, 1903, 1904.—Axelson, 1903*b*, 1904, 1905*b*, 1906.—(Axelson) Linnaniemi, 1907, 1909, 1911, 1912.—Wahlgren, 1906.—Shoebotham, 1914.

Onychiurus arcticus Axelson, 1903*b*.

Aphorura ambulans Guthrie, 1903.

Onychiurus armatus var. *arctica* (Axelson) Linnaniemi, 1909, 1912.

White. Elongate; abdomen slightly dilated (fig. 5). Postantennal organs (fig. 43) elongate-elliptical, each with 18 to 44 (usually

25 to 35) simple peripheral tubercles. Pseudocelli of head as follows: Antennal base, 3+3 (fig. 44) arranged in a triangle on each side; posterior border of head, 3+3, occasionally 4+4. Antennae almost as long as the head. Sense organ of third antennal segment (fig. 45) with five (abnormally six) papillae, five guard setae, two sense rods, and two capitate tuberculate sense clubs. Pseudocelli of body (fig. 5) as follows—Prothorax: dorsal, 0; lateral, (proximal precoxal), 1+1. Mesothorax: dorsal, 2+2; lateral (proximal precoxal), 1+1. Metathorax: dorsal, 3+3; lateral (proximal precoxal), 1+1. First, second and third abdominal segments: dorsal, 3+3. Fourth abdominal : dorsal, 3+3; postero-lateral, 1+1. Fifth abdominal: Dorsal, 3+3; antero-lateral, 1+1; the three dorsal on each side lying close together in a straight line. Sixth abdominal, 0. Unguis (fig. 46) curving, untoothed, or minutely unidentate one third from apex, especially on the front feet. Unguiculus gradually tapering, distally attenuate, as long as, or a little longer than, the unguis. Furcula represented by a crescentic fold (figs. 47, 48); tenaculum absent. Anal spines (fig. 49) two, large, almost as long as hind ungues, arcuate or almost straight, on prominent papillae one-third as long as the spines. Clothing (fig. 50) of numerous short curving setae and fewer long stiff setae, becoming longer on the posterior part of the abdomen. Cuticular tubercules moderate in size (fig. 51). Length, 1.8 mm.

In one specimen the right sense organ of the third antennal segment showed six papillae (fig. 45). Ågren ('03, p. 128) mentions the occurrence in one specimen of seven papillae and three sense clubs.

According to European writers (see Ågren, '04, p. 12) the pseudocelli of the antennal base are rarely four on each side; those of the posterior border of the head varying from two to four on each side; of the mesonotum, one to three; metanotum, one to three; fourth abdominal segment, three or four, rarely two; and those on the posterior part of the fifth abdominal segment, two to four on each side. These variations I have not yet found in this country.

The unguiculus varies a little in length, extending sometimes not quite as far as the unguis.

My North American specimens agree accurately with European descriptions and with European examples sent to me by Dr. Caesar Schäffer.

The form that Guthrie ('03, p. 97) termed *ambulans* is *armatus*, as I have found by an examination of nine of his specimens, sent to me by Prof. Henry F. Nachtrieb.

Ågren ('04, p. 12) found, from his study of the type material, that *O. arcticus* Tullberg is not specifically distinct from *O. armatus* Tullberg, being simply a large variety, 3.5 mm. in length (maximum length, 4.1 mm., according to Skorikow).

Axelson ('05*b*, p. 790; '12, p. 88) has named as *inermis* a variety of *armatus* in which the anal spines and their papillae are absent.

I have taken this species on damp soil under wood or dead leaves and under the loose bark of decaying logs. In Europe, and doubtless in this country as well, the species occurs also in moss, under stones, in decaying vegetables, in flower pots, on pools of fresh water, on the seashore under stones, wood, or seaweed, and in caves.

Onychiurus armatus is very common everywhere in Europe. It has been reported also from Siberia, Greenland, and other Arctic localities, and from East Africa and Chile.

Maine: Orono, F. L. Harvey

Illinois: Homer, April 3, May 7, 8, 21, June 6. Urbana, April 12, 25.

ONYCHIURUS PSEUDARMATUS, new species.

Plate 68, fig. 6; plate 74, figs. 52–60.

White, slender (fig. 6). Postantennal organs (fig. 52) elongate, elliptical, each with about 40 simple tubercles, crowded together. Pseudocelli of antennal bases 3+3 (fig. 53), arranged almost in a straight line. Posterior border of head with 2+2 pseudocelli, in oblique pairs. Antennae shorter than the head. Sense organ of third antennal segment (fig. 54) with five papillae; five guard setae; a pair of tapering sense rods; two capitate, coarsely tuberculate sense clubs; and a large subovate finely tuberculate accessory club (fig. 54). Dorsal pseudocelli of body segments (fig. 6): 0, 1+1, 1+1, 2+2, 2+2, 2+2, 2+2, 3+3, 0. Those of the first four abdominal segments are in oblique pairs; each group on the fifth abdominal segment forms a triangle. Unguis feebly curving, unidentate (fig. 55) or unarmed (fig. 56). Unguiculus extending more than half as far as the unguis, basally suboblong, apically tapering uniformly. Furcula represented by a fold (fig. 57). Anal spines (fig. 58) stout, almost straight, two-thirds as long as hind ungues, on well separated papillae one-third as long as the spines. Clothing (fig. 59) of sparse short setae, stiff or slightly curving, and fewer long stiff setae. Cuticular tubercles large (fig. 60). Length, 3 mm.

This species is much like the well known *armatus*, but shows in addition to the differences given in my key (p. 639) other differences in respect to the antennal sense organs, the length of the anal spines, the form of the rudimentary furcula, the size of the cuticular tubercles and the character of the clothing.

Alaska.—Saint Paul Island, Pribilof Group, August 6, in moss, Prof. Trevor Kincaid.

Cotypes.—Cat. No. 20760, U.S.N.M.

ONYCHIURUS OCTOPUNCTATUS Tullberg.

Plate 75, figs. 61–64.

Lipura octo-punctata TULLBERG, 1876.—SCHÖTT, 1894.
Aphorura octopunctata SCHÄFFER, 1900*a*.—FOLSOM, 1902.

White. Postantennal organs (fig. 61) elliptical, each with about 33 to 37 simple tubercles. Pseudocelli of antennal bases 4+4 (fig. 61); of posterior border of head 3+3. Antennae shorter than the head. Sense organ of third antennal segment with five papillae (fig. 62). Unguis (fig. 63) broad, curving, unidentate near the middle of the inner margin. Unguiculus a little longer than unguis, slender, gradually attenuating into a fine filament, untoothed. Anal spines (fig. 64) two, half as long as unguis, stout, feebly arcuate, on prominent papillae. Body sparsely clothed with short curving setae and occasional longer stiff setae, the latter becoming more numerous toward the extremity of the abdomen. Length, 2.7 mm.

The only examples of this species that I have seen are three from Alaska, taken by the Harriman Expedition in 1899. These specimens agree with the original description and figures except for lacking a tooth on the unguiculus. The pseudocelli of the body were not studied on account of insufficient material.

O. octopunctata has seldom been recorded. It was described from a single individual taken at Dudinskoe, Siberia (latitude 69° 25′ N.) by the Nordenskiöld Expedition in 1875 (Tullberg, '76, p. 40). The Yenisei Expedition of the following year collected examples at Tschulkova (latitude 62° 45′ N.) and the *Vega* Expedition of 1878–79 found a single specimen at Irkaipi, in Chukchi Land (latitude 68° 36′ N. Schött, '94, p. 88).

Sitka, Alaska, June, Prof. Trevor Kincaid (U.S.N.M., Harriman Collection, No. 71).

ONYCHIURUS DENTATUS Folsom.

Plate 69, fig. 7; plate 75, figs. 65–68; plate 76, figs. 69–75.

Aphorura dentata FOLSOM, 1902.

White (fig. 7). Postantennal organs (fig. 65) elongate, each with hundreds of closely set papillae, which arise from about 17 tubercles, the stalks of which are shown in section in figure 66. Pseudocelli of antennal bases 2+2 (fig. 67). Antennae slightly shorter than the head, with segments related nearly as 2:5:4:5 in relative lengths. Sense organ of third antennal segment (fig. 68) with five (rarely four) stout subconical papillae, five guard setae, a pair of slender fusiform sense rods and two papillate sense clubs. Unguis (figs. 69, 70) strongly curving, basally tuberculate, five or six toothed, as follows: paired pseudonychial teeth occur one-third from the base of the claw; a second pair of lateral teeth is present near the apex of the claw; and one or two distal teeth are situated on the outer margin.

Unguiculus untoothed, shorter than, or longer than, the unguis, narrowly lamellate proximally, gradually tapering or attenuating distally, tuberculate basally. Fourth and fifth abdominal segments each with 2+2 pseudocelli, in oblique pairs. Anal spines (figs. 71, 72) two, less than half as long as hind ungues, almost straight, separated basally, with papillae reduced to rings. Clothing (figs. 73, 74) of dense short curving setae, with occasional long stiff setae. Cuticular tubercles of moderate size (fig. 75). Maximum length, 4 mm.

I have here improved my original diagnosis of this species by the addition of a more precise description of the antennal sense organ and by a correction of my former statement in regard to the pseudocelli. Almost all the structures that I described as pseudocelli are in reality cuticular pits that form the sockets of exceptionally large setae, and these sockets can be distinguished by their structure from pseudocelli by means of high magnification. Most of the setae were missing in my specimens, but the occasional setae that remained in place were sufficient in number to enable me to reconstruct the arrangement of setae as given in figure 7.

The cotypes were collected by Prof. Trevor Kincaid, of the Harriman Alaska Expedition, from whom I received a few additional specimens after the description was published.

Seldovia, Cook Inlet, July, under stones at tide mark (No. 62). Cook Inlet (No. 60). St. Paul Island, Bering Sea, August 1. Unalaska, September, beneath stones covered with barnacles.

Cotypes.—Cat. No. 5436, U.S.N.M.

ONYCHIURUS RAMOSUS, new species.

Plate 69, fig. 8; plate 76, figs. 76, 77; plate 77, figs. 78–82.

White. Postantennal organs (fig. 76) each with about 13 many-lobed tubercles, of the *fimetarius* type. Pseudocelli behind the antennal bases 2+2, with wide ringlike borders (fig. 77). Antennae shorter than the head. Sense organ of third antennal segment (fig. 78) with four papillae, three guard setae, a pair of sense rods and two capitate coarsely tuberculate sense clubs. Dorsal pseudocelli of body (fig. 8): 0, 1+1, 1+1, 1+1, 0, 0, 2+2, 2+2, 0; those of the fourth and fifth abdominal segments being in oblique pairs. Lateral and ventral pseudocelli absent. Unguis (fig. 79) stout, curving, untoothed. Unguiculus gradually tapering from base to apex, extending half as far as the unguis. Anal spines (fig. 80) two, half as long as hind ungues, arcuate, on low contiguous papillae. Clothing (fig. 81) of sparse, short, stiff setae and a few minute curving setae. Cuticular tubercles minute (fig. 82). Length, 1.3 mm.

This is the only one of our known species which has, at the same time, branched postantennal tubercles of the *fimetarius* type and

anal spines. I have found it rather common among grass roots and in the woods under damp logs.

Illinois: Homer, April 3, May 7, 8. Urbana, April 12, 18, October 26.

Cotypes.—Cat. No. 20761, U.S.N.M.

ONYCHIURUS FIMETARIUS Linnaeus, Lubbock.

Plate 69, fig. 9; plate 77, figs. 83–86; plate 78, figs. 87, 88.

Podura fimetaria LINNAEUS, 1767.—FABRICIUS, 1793.

Lipura fimetaria BURMEISTER, 1838.—LUBBOCK, 1868, 1873.—PACKARD, 1873.—PARONA, 1879, 1888.—OUDEMANS, 1890.—UZEL, 1890, 1891.—MACGILLIVRAY, 1891.—CARPENTER and EVANS, 1899.

Lipura volvator GERVAIS, 1844.

Anurophorus fimetarius NICOLET, 1847 (not of 1841).

Lipura inermis TULLBERG, 1869, 1871, 1872.—REUTER, 1890, 1895.—SCHÖTT, 1891, 1894*a*, 1894*b*, 1896.—MACGILLIVRAY, 1894.—LIE-PETTERSEN, 1896.

Lipura wrightii CARPENTER, 1895, 1897.

Aphorura inermis SCHÄFFER, 1896, 1900*b*.—CARL, 1899.—ABSOLON, 1900*a*, 1900*b* 1901*a*, 1901*b*.—KRAUSBAUER, 1902.—SCHÖTT, 1902.

Aphorura fimetaria CARL, 1899.

Onychiurus inermis BÖRNER, 1902*a*.—VOIGTS, 1902.

Onychiurus fimetarius ÅGREN, 1903, 1904.—AXELSON, 1905*a*, 1906.—(AXELSON) LINNANIEMI, 1907, 1912.—COLLINGE and SHOEBOTHAM, 1910.—CAROLI, 1914.

White. Abdomen broad, rounded behind (fig. 9). Postantennal organs (fig. 83) elongate, each with 8 to 17 branched tubercles. Pseudocelli of head as follows: Antennal base, 2+2; behind antennal base, 1+1; posterior border of head, 1+1 or 2+2; ventral surface of head, 1+1. Antennae shorter than the head. Sense organ of third antennal segment (fig. 84) with four slender papillae, five guard setae, two sense rods, and two ovate erect smooth sense clubs. Pseudocelli of body (fig. 9) as follows: Prothorax—dorsal, 1+1; proximal precoxal segment, 2+2. Mesothorax—dorsal, 2+2; proximal precoxal, 2+2; antero-ventral, 1+1. Metathorax—dorsal, 2+2; proximal precoxal, 2+2; antero-ventral, 1+1. First abdominal segment: Dorsal, 3+3; lateral (base of ventral tube), 1+1; antero-lateral, 1+1. Second abdominal: Dorsal, 3+3; antero-ventral (behind ventral tube), 1+1; postero-ventral, 1+1. Third abdominal: Dorsal, 3+3; ventro-lateral, 1+1; postero-ventral, 1+1. Fourth abdominal: Dorsal aspect, 5+5 (dorsal, 3+3; lateral, 2+2); postero-ventral, 1+1. Fifth abdominal: Dorsal, 3+3; ventral, 1+1. Sixth abdominal: 0. Unguis (figs. 85, 86) slender, curving, untoothed. Unguiculus gradually tapering, distally attenuate, three-fourths as long as unguis. Anal spines absent. Anus ventral. Clothing (fig. 87) of sparse short setae, a little longer and stiffer on the posterior part of the abdomen. Cuticular tubercles relatively coarse (fig. 88); coarser on the head than on the body. Length, often 1.8 mm.; maximum, 2.1 mm.

I sent specimens from Massachusetts to Dr. Caesar Schäffer, who informed me that they were *Lipura inermis* Tullberg, the equivalent of *L. fimetaria* Linnaeus, Lubbock; and I was able to verify his opinion by an examination of many European specimens which he sent to me.

In Swedish specimens Ågren ('03) found 3+3 pseudocelli on the posterior border of the head and found the unguiculus to exceed the unguis in length. The same author ('04) gives the number of lateral pseudocelli of each thoracic segment as 1+1; I find, however, 2+2 and record also several lateral and ventral pseudocelli not as yet mentioned by European writers.

Packard's ('73) *Lipura fimetaria* (Linnaeus), which I examined in the Museum of Comparative Zöology, is this species—the *fimetaria* of Linnaeus as redescribed by Lubbock.

The form with eight or nine tubercles in each postantennal organ, found in Europe and North America, varies into forms with a larger number of tubercles, as Carpenter and Evans ('99) have noted. The species from Japan that I referred to *Aphorura inermis* Tullberg (Folsom, '99) was named *A. folsomi* by Schäffer ('00*a*, p. 249), and differs from *inermis* in the structure of the antennal sense organ, as I have recently found (see Börner, '09, p. 104).

The form referred to *inermis* Tullberg by Guthrie ('03) is not that species but is the form described beyond as *pseudofimetarius*, as I have found by an examination of some of Guthrie's specimens.

The Californian specimens that I have seen, collected by Miss Gertrude A. Bacon, agree with European examples.

This species is common in humus, under dead leaves, decaying logs, or loose dead bark, in moss, in flower pots in dwelling houses, and in greenhouses. In Europe it has been found also in caves and occasionally on the seashore.

Onychiurus fimetarius is common throughout Europe, is widely distributed in North America, and has been reported from Africa and Sumatra.

Massachusetts: Belmont, March 27; Cambridge (in a greenhouse), February 2, 7, March 1, July 17; Salem, A. S. Packard (M. C. Z).

Pennsylvania: Hazleton, W. G. Dietz.

Florida: E. Lönnberg (see MacGillivray, '94).

California: G. Eisen (Cal. Acad. Sc.); Santa Barbara, February 28, Gertrude A. Bacon.

ONYCHIURUS PSEUDOFIMETARIUS, new species.

Plate 69, fig. 10; plate 78, figs. 89–94.

Aphorura inermis GUTHRIE, 1903.

White. Body slender; abdomen rounded posteriorly (fig. 10). Postantennal organs (fig. 89) elongate, each with about 16 branched

tubercles. Dorsal pseudocelli of head as follows (fig. 10): Antennal bases, 2+2; behind antennal bases, 1+1; posterior border of head, 3+3. Ventral pseudocelli of head as follows: Anterior, 1+1; posterior, 1+1. Antennae slightly shorter than the head. Sense organ of third antennal segment (fig. 90) with five slender papillae, five guard setae, two sense rods, and two subreniform smooth oblique sense clubs. Pseudocelli of body as follows—Prothorax: Pronotum, 0; proximal precoxal, 2+2; coxal, 1+1. Mesothorax and metathorax: Dorsal, 3+3; antero-ventral, 1+1; proximal precoxal, 2+2; coxal, 1+1. First abdominal segment: Dorsal aspect, 4+4; antero-ventral, 1+1; base of ventral tube, 2+2 (lateral and posterior, respectively). Second abdominal: Dorsal aspect, 4+4; postero-ventro-lateral, 1+1. Third abdominal: Dorsal aspect, 3+3; postero-ventro-lateral, 1+1. Fourth abdominal: Dorsal, 3+3; lateral, 3+3 or 2+2; postero-ventro-lateral, 1+1. Fifth abdominal: Dorsal, 3+3; postero-lateral, 1+1. Sixth abdominal: 0. Unguis (figs. 91, 92) curved, untoothed. Unguiculus extending a little more than half as far as the unguis, broadly lamellate proximally, attenuate distally. Anal spines absent. Anus ventral. Clothing (fig. 93) of short sparse setae, becoming longer and stiffer posteriorly. Cuticular tubercles relatively minute (fig. 94). Length, 1.5 mm.

Pseudofimetarius is close to *fimetarius*, the arrangement of most of the dorsal pseudocelli being essentially the same in the two species, though the former species differs in having no pronotal pseudocelli and in having 3+3 pseudocelli on the posterior border of the head (this latter condition occurring, however, as a variation in some Swedish examples of *fimetarius*). *Pseudofimetarius* differs further from *fimetarius* in having four pseudocelli on the ventral surface of the head and differs markedly in the structure of the sense organ of the third antennal segment.

This is the form that Guthrie ('03) referred to *Aphorura inermis* Tullberg, as I learned from a study of two of Guthrie's specimens, loaned to me by Prof. Henry F. Nachtrieb.

This species occurs on damp soil under decaying logs or dead leaves.

Illinois: Homer, April 2, 3, 9, May 7, 8, November 7. Urbana, March 13, 17, April 3, 5, 11, 25.

Minnesota: April 8, J. E. Guthrie (Univ. of Minn.).

Cotypes.—Cat. No. 20762, U.S.N.M.

Genus TULLBERGIA Lubbock, Börner.

Tullbergia Lubbock 1876.
Stenaphorura Absolon 1900*b*.
Mesaphorura Börner 1901*a*.
Boerneria Willem 1902.
Tullbergia Börner 1902*b*.

Body extremely slender, gradually tapering toward each end. Head relatively small, narrower than the prothorax. Antennal base absent in a few species. Postantennal organs each in a transverse groove, a little behind the antennal base, with simple tubercles, usually numerous. Sense organ of third antennal segment with two or three papillae, or with papillae absent or represented by a cuticular ridge; with two, three, or four guard setae; a pair of sense rods; and two or three sense clubs, smooth and straight or curving toward one another; in addition there is usually an isolated ventrolateral sense club. Fourth antennal segment with curving sense hairs, with apical sense club and without subapical papilla. Tarsus with one or two claws. Furcula absent. Anal spines 0–4, with additional spine-like tubercles in a few species. Pseudocelli rarely rudimentary.

TULLBERGIA COLLIS Bacon.

Plate 69, fig. 11; plate 78, fig. 95; plate 79, figs. 96–101.

Tullbergia collis Bacon, 1914.

White. Slender (fig. 11); five to six times as long as broad. Postantennal organs (fig. 95) large, oblong-elliptical, each with about 75 tubercles in four parallel rows Pseudocelli large, with wide rings. Dorsal pseudocelli of head (fig. 11) as follows: Antennal bases, 1+1; posterior border, 1+1. Antennae shorter than the head. Sense organ of third antennal segment (fig. 96) with four guard setae; four low blunt papillae, sometimes reduced to an irregular ridge; two clavate curving sense rods; two smooth clavate or subreniform sense clubs curving toward each other; and an inner clavate accessory sense club. Curving sensory setae of fourth antennal segment (fig. 97) as follows: Two outer, one dorsal, five inner. One pair of dorsal pseudocelli on each segment of the body except the anal segment. Unguis (fig. 98) stout, curving, untoothed. Unguiculus reduced, spiniform. Anal spines (figs. 99, 100) two, arcuate, as long as hind ungues, on large contiguous papillae. Clothing (fig. 101) of sparse short stiff setae. Length, 1.5 mm.

Tullbergia collis, the only known representative of its genus in this country, was discovered in California, in the hills near Pomona and Laguna Beach, and described by Miss Gertrude A. Bacon, who kindly sent me cotypes which have enabled me to supplement the original description.

Genus TETRODONTOPHORA Reuter.

Tetrodontophora Reuter, 1882.
Tetrodontophora Absolon, 1901*c*.
Tetrodontophora Börner, 1902*a*.

Head and body stout. Antennal base present. Postantennal organs absent. Sense organ of third antennal segment with seven

guard setae, 14 or 15 papillae in three rows, three erect sense clubs, and two sense rods. Tarsus with two claws, the unguis being pseudonychiate (as in *Tomocerus*). Furcula present, normally developed, on the fourth abdominal segment. Tenaculum present. Anal and genital segments confluent. Abdomen posteriorly six-lobed, with two anal spines and four spine-like tubercles.

The genus *Tetrodontophora*, which has not as yet been found on this continent, is based upon the European *T. bielanensis* Waga (*gigas* Reuter), a cavernicolous species, dark blue, and of relatively large size, attaining a length of 9.2 mm.

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EXPLANATION OF PLATES.

PLATE 68.

Fig. 1. *Onychiurus similis*, ×47.
2. *Onychiurus cocklei*, ×30.
3. *Onychiurus subtenuis*, ×43.
4. *Onychiurus litoreus*, ×45.
5. *Onychiurus armatus*, ×44.
6. *Onychiurus pseudarmatus*, ×25.

PLATE 69.

Fig. 7. *Onychiurus dentatus*, ×16.
8. *Onychiurus ramosus*, ×62.
9. *Onychiurus fimetarius*, ×40.
10. *Onychiurus pseudofimetarius*, ×61.
11. *Tullbergia collis*, ×45.

PLATE 70.

Fig. 12. *Onychiurus similis*, left postantennal organ, ×1120.
13. *Onychiurus similis*, left antennal sense organ, ×1120.
14. *Onychiurus similis*, left hind foot, ×652.
15. *Onychiurus similis*, anal segment, ×166.
16. *Onychiurus similis*, left anal spine, ×652.
17. *Onychiurus similis*, clothing, median dorsal line of first abdominal segment, ×346.
18. *Onychiurus similis*, cuticular tubercles of body, ×652.
19. *Onychiurus cocklei*, right postantennal organ, ×1232.
20. *Onychiurus cocklei*, left antennal base, ×200.

PLATE 71.

Fig. 21. *Onychiurus cocklei*, left antennal sense organ, ×1120.
22. *Onychiurus cocklei*, left hind foot, ×652.
23. *Onychiurus cocklei*, anal segment, ×166.
24. *Onychiurus cocklei*, right anal spine, ×400.
25. *Onychiurus cocklei*, clothing, median line of metanotum, ×300.
26. *Onychiurus cocklei*, clothing, median dorsal line of first abdominal segment, ×520.
27. *Onychiurus cocklei*, clothing, median dorsal line of first abdominal segment, ×346.
28. *Onychiurus cocklei*, cuticular tubercles of body, ×652.

PLATE 72.

Fig. 29. *Onychiurus subtenuis*, left postantennal organ, ×1120.
30. *Onychiurus subtenuis*, left postantennal organ, ×1120.
31. *Onychiurus subtenuis*, left antennal base, ×346.
32. *Onychiurus subtenuis*, left antennal sense organ, ×1120.
33. *Onychiurus subtenuis*, right hind foot, ×652.
34. *Onychiurus subtenuis*, anal segment, ×166.
35. *Onychiurus subtenuis*, left anal spine, ×260.
36. *Onychiurus subtenuis*, anal spines, ×260.
37. *Onychiurus subtenuis*, clothing, median dorsal line of first abdominal segment, ×346.
38. *Onychiurus subtenuis*, cuticular tubercles of body, ×652.

PLATE 73.

Fig. 39. *Onychiurus litoreus*, right postantennal organ, ×504.
40. *Onychiurus litoreus*, right mid foot, ×980.
41. *Onychiurus litoreus*, anal spines, ×652.
42. *Onychiurus litoreus*, cuticular tubercles of body, ×652.
43. *Onychiurus armatus*, right postantennal organ, ×1120.
44. *Onychiurus armatus*, pseudocellus of antennal base, ×1120.
45. *Onychiurus armatus*, right antennal sense organ, with six papillae as an abnormality, ×1120.

Fig. 46. *Onychiurus armatus*, right hind foot, ×614.
47. *Onychiurus armatus*, ventral aspect of rudimentary furcula, ×652.
48. *Onychiurus armatus*, left aspect of rudimentary furcula, ×386.
49. *Onychiurus armatus*, left anal spine, ×386.
50. *Onychiurus armatus*, clothing, median dorsal line of first abdominal segment, ×346.
51. *Onychiurus armatus*, cuticular tubercles of body, ×652.

PLATE 74.

Fig. 52. *Onychiurus pseudarmatus*, postantennal organ, ×646.
53. *Onychiurus pseudarmatus*, left antennal base, ×394.
54. *Onychiurus pseudarmatus*, right antennal sense organ, ×1120.
55. *Onychiurus pseudarmatus*, left fore foot, ×380.
56. *Onychiurus pseudarmatus*, left hind foot, ×380.
57. *Onychiurus pseudarmatus*, ventral aspect of rudimentary furcula, ×652.
58. *Onychiurus pseudarmatus*, left anal spine, ×226.
59. *Onychiurus pseudarmatus*, clothing, median dorsal line of first abdominal segment, ×226.
60. *Onychiurus pseudarmatus*, cuticular tubercles of body, ×652.

PLATE 75.

Fig. 61. *Onychiurus octopunctatus*, right postantennal organ, ×434.
62. *Onychiurus octopunctatus*, right anntennal sense organ, ×868.
63. *Onychiurus octopunctatus*, left hind foot, ×434.
64. *Onychiurus octopunctatus*, left anal spine, ×425.
65. *Onychiurus dentatus*, right postantennal organ, etc., ×1120.
66. *Onychiurus dentatus*, deeper structure of postantennal organ, ×868.
67. *Onychiurus dentatus*, base of right antenna, ×254.
68. *Onychiurus dentatus*, left antennal sense organ, ×1120.

PLATE 76.

Fig. 69. *Onychiurus dentatus*, right hind foot, ×346.
70. *Onychiurus dentatus*, right mid foot, concave aspect, ×346.
71. *Onychiurus dentatus*, anal spines, ×400.
72. *Onychiurus dentatus*, right anal spine, ×400.
73. *Onychiurus dentatus*, clothing, median dorsal line of first abdominal segment, ×166.
74. *Onychiurus dentatus*, clothing, median line of metanotum, ×166.
75. *Onychiurus dentatus*, cuticular tubercles of body, ×652.
76. *Onychiurus ramosus*, left postantennal organ, ×1120.
77. *Onychiurus ramosus*, left antennal base, ×652.

PLATE 77.

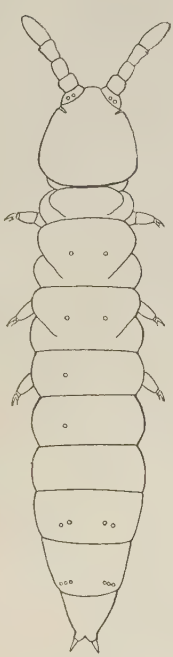
Fig. 78. *Onychiurus ramosus*, right antennal sense organ, ×1640.
79. *Onychiurus ramosus*, left hind foot, ×980.
80. *Onychiurus ramosus*, anal spine, ×980.
81. *Onychiurus ramosus*, clothing, median line of first abdominal segment, ×346.
82. *Onychiurus ramosus*, cuticular tubercles of body, ×652.
83. *Onychiurus fimetarius*, right postantennal organ, ×1120.
84. *Onychiurus fimetarius*, left antennal sense organ, ×1120.
85. *Onychiurus fimetarius*, right hind foot, ×486.
86. *Onychiurus fimetarius*, right hind foot, ×466.

PLATE 78.

Fig. 87. *Onychiurus fimetarius*, clothing, median line of first abdominal segment, ×346.
88. *Onychiurus fimetarius*, cuticular tubercles of head, ×1120.
89. *Onychiurus pseudofimetarius*, right postantennal organ, ×1120.
90. *Onychiurus pseudofimetarius*, left antennal sense organ, ×1120.
91. *Onychiurus pseudofimetarius*, left hind foot, ×652.
92. *Onychiurus pseudofimetarius*, left hind foot, ×780.
93. *Onychiurus pseudofimetarius*, clothing, median line of first abdominal segment, ×346.
94. *Onychiurus pseudofimetarius*, cuticular tubercles of head, ×1120.
95. *Tullbergia collis*, right postantennal organ, ×1120.

PLATE 79.

Fig. 96. *Tullbergia collis*, right antennal sense organ, ×1680.
97. *Tullbergia collis*, dorsal aspect of fourth antennal segment of right side, ×1120.
98. *Tullbergia collis*, left fore foot, ×652.
99. *Tullbergia collis*, anal spines, ×652.
100. *Tullbergia collis*, right anal spine, ×652.
101. *Tullbergia collis*, clothing, median line of first abdominal segment, ×520.



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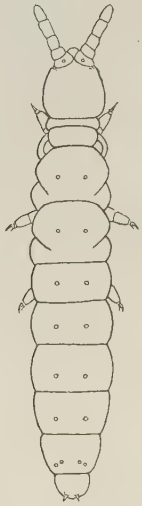

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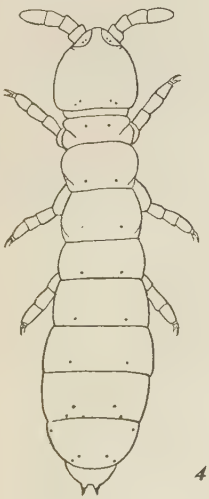

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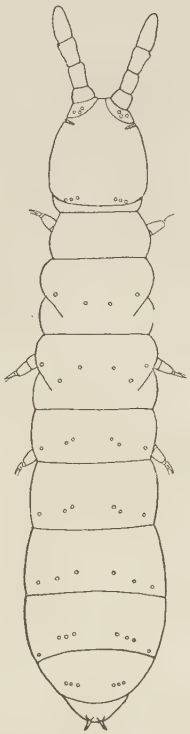
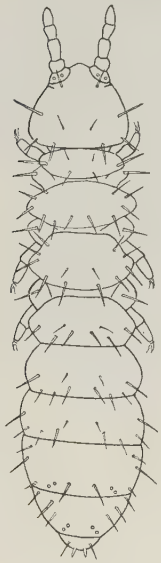


5

6

NORTH AMERICAN ONYCHIURINAE.

FOR EXPLANATION OF PLATE SEE PAGE 656.



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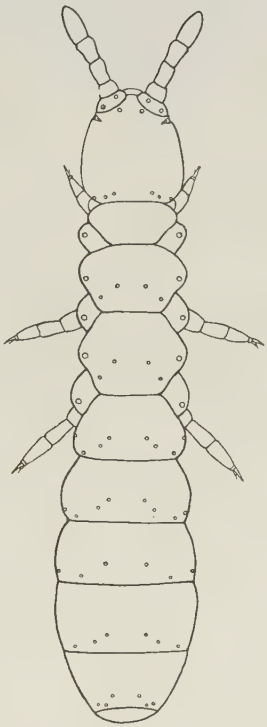

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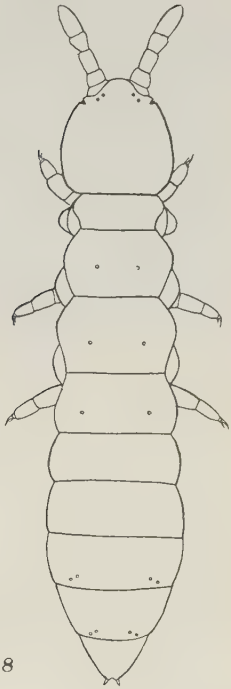

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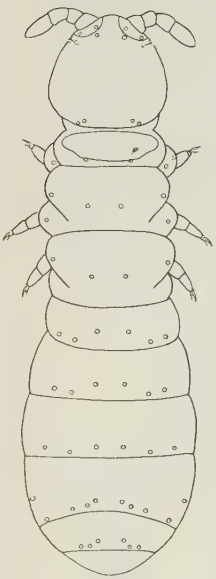

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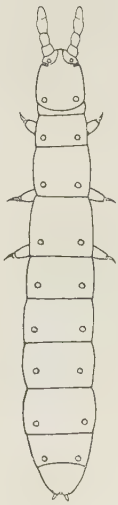

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FOR EXPLANATION OF PLATE SEE PAGE 657.

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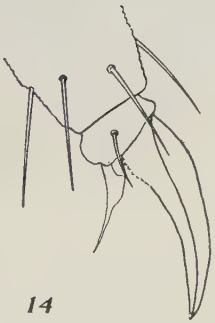

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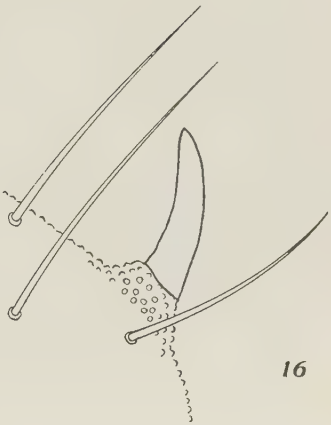

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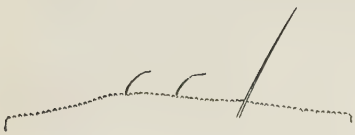

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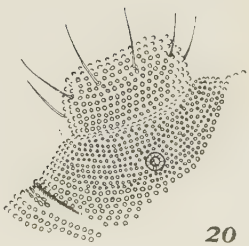

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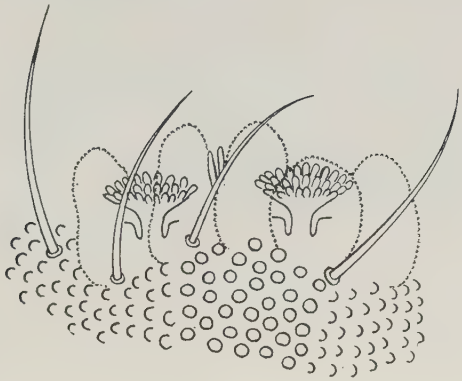

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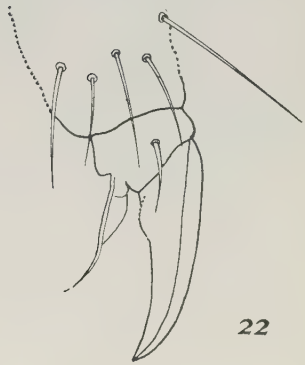

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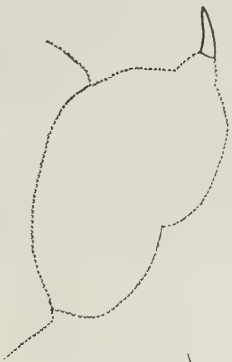

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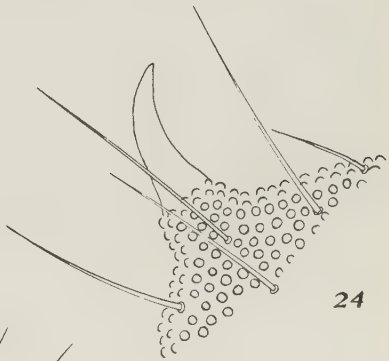

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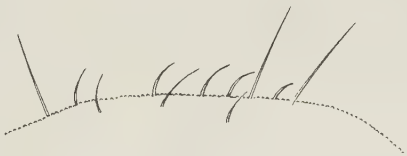

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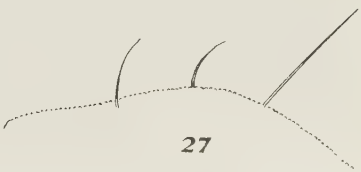

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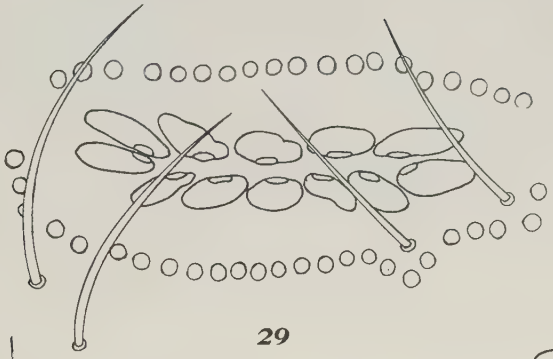
North American Onychiurinae.

For explanation of plate see page 657.



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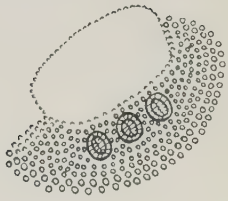

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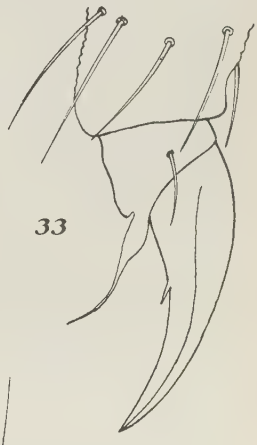

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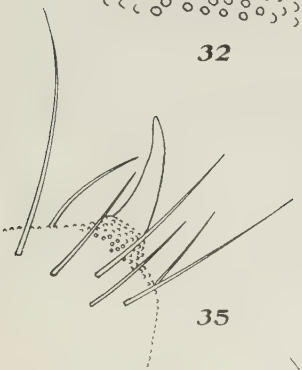

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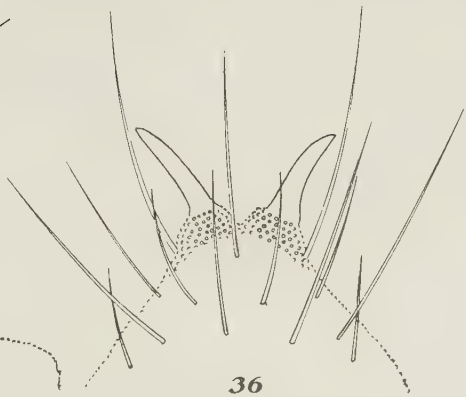

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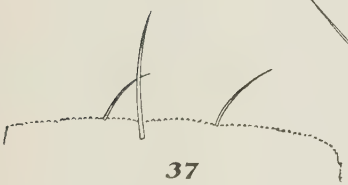

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NORTH AMERICAN ONYCHIURINAE.

FOR EXPLANATION OF PLATE SEE PAGE 657.

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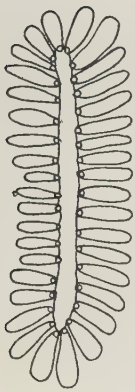

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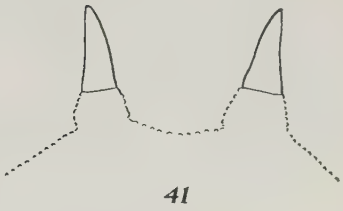

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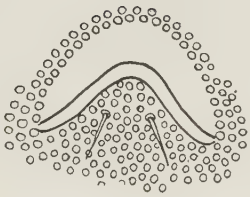

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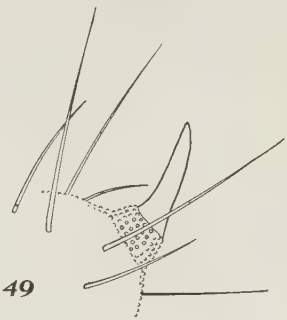

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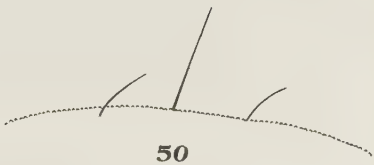

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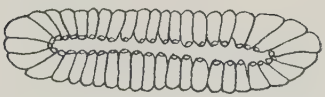
NORTH AMERICAN ONYCHIURINAE.

FOR EXPLANATION OF PLATE SEE PAGES 657-658.



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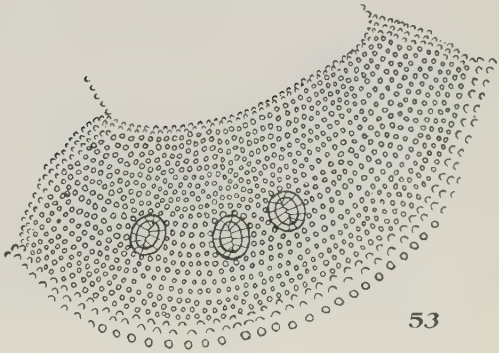

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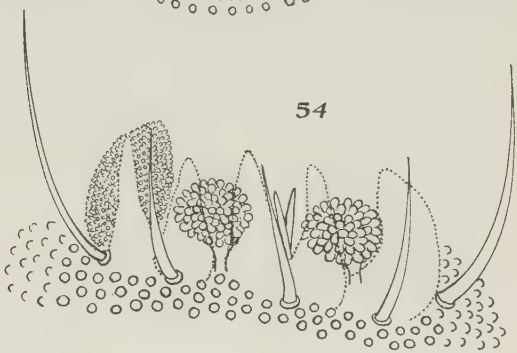

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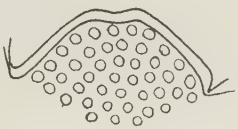

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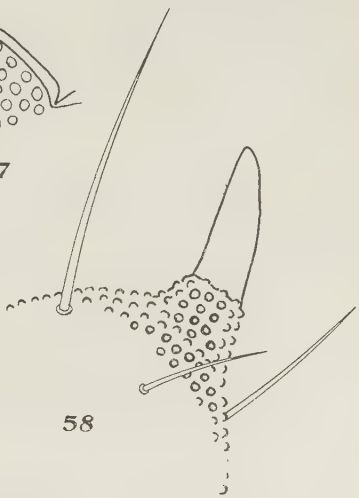

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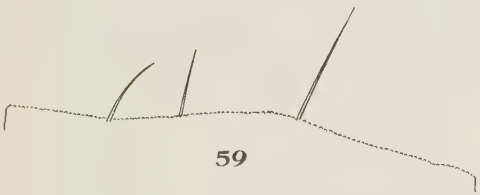

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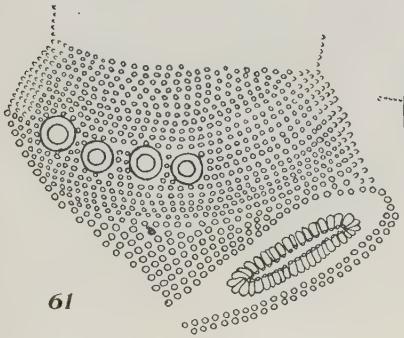
FOR EXPLANATION OF PLATE SEE PAGE 658.



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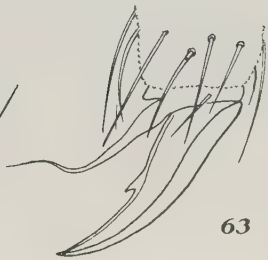

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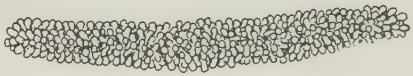

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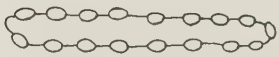

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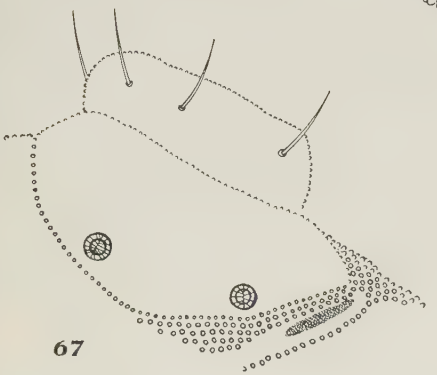

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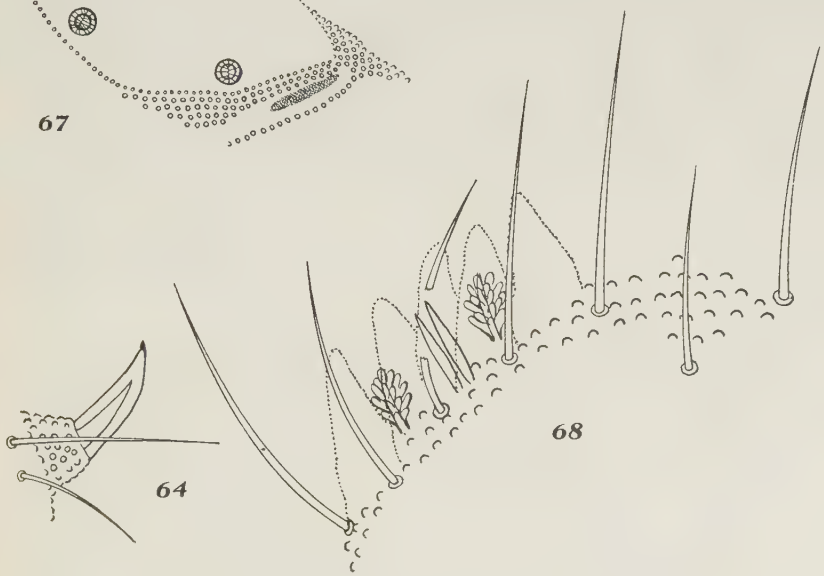

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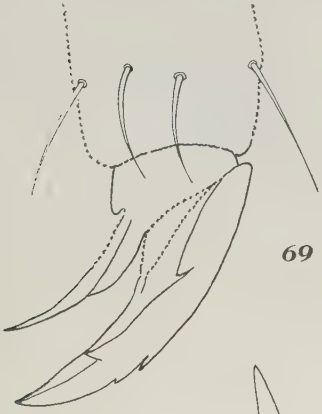

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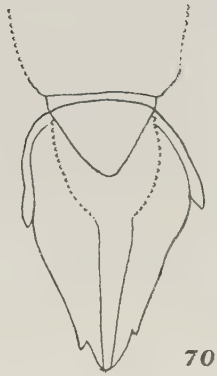

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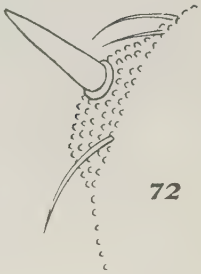

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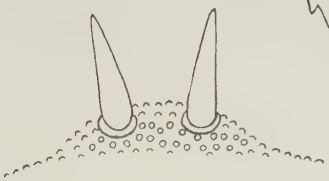

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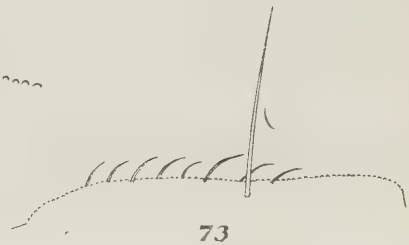

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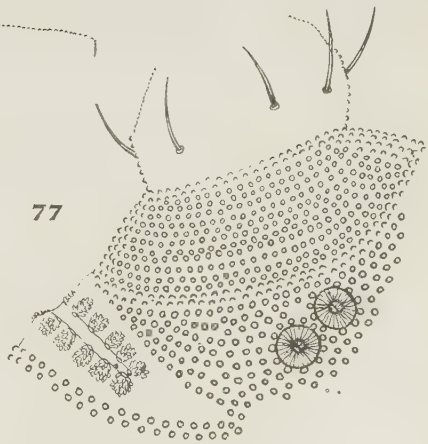

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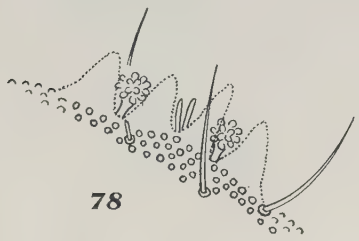

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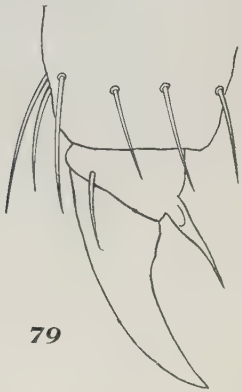

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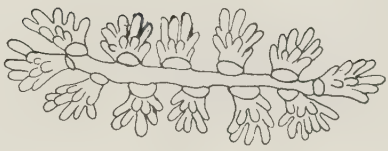

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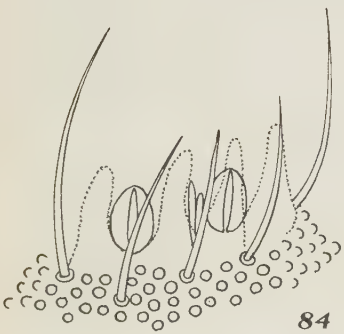

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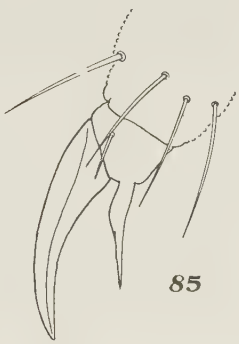

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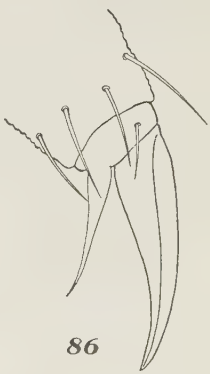

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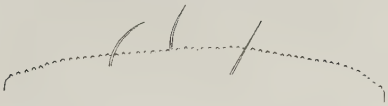

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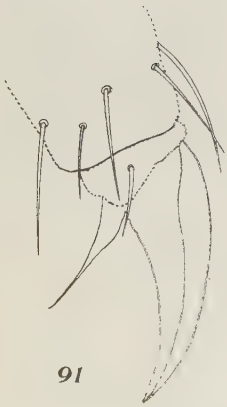

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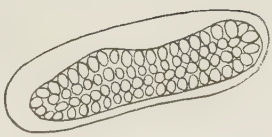

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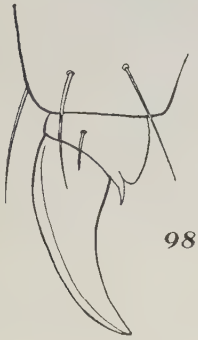

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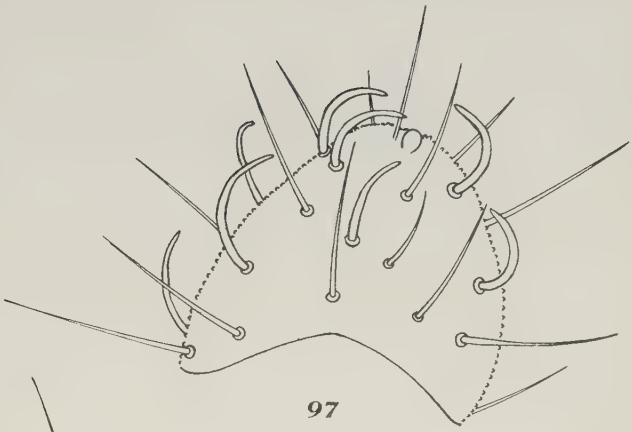

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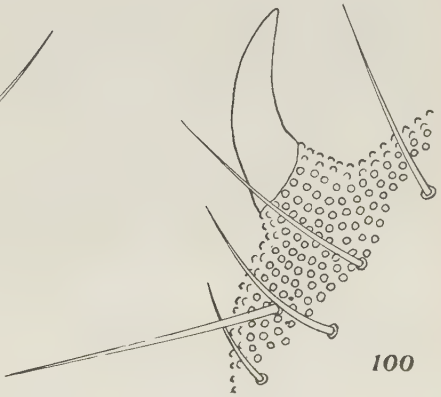

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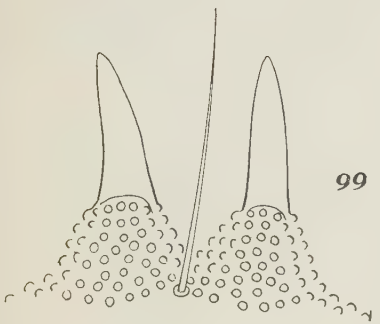

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